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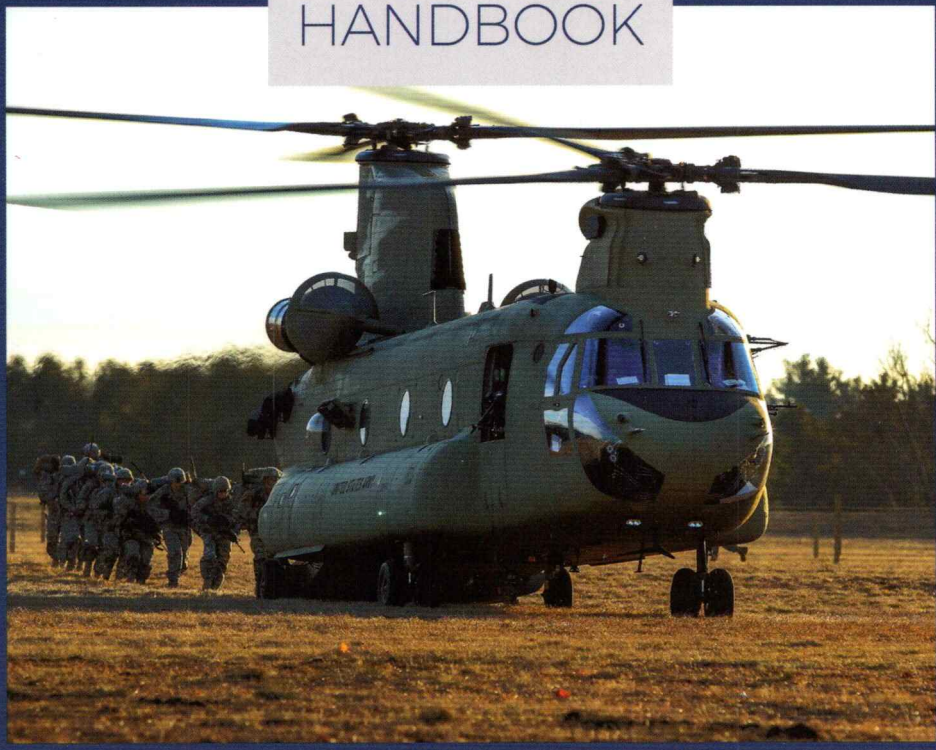
HANDBOOK



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3 Introduction
VP Content Tony Skinner welcomes readers to Issue 31 of Shephard Media's *Military Helicopter Handbook*.

5 Rotorcraft
Concise descriptions, photographs and specification data on the world's major military helicopters.

54 Engines
An illustrated selection of helicopter powerplants, specifying engine models in production.

64 Integrated mission systems
A selection of integrated mission management systems for military rotorcraft.

74 Communications equipment
A range of communications systems commonly installed on military helicopters.

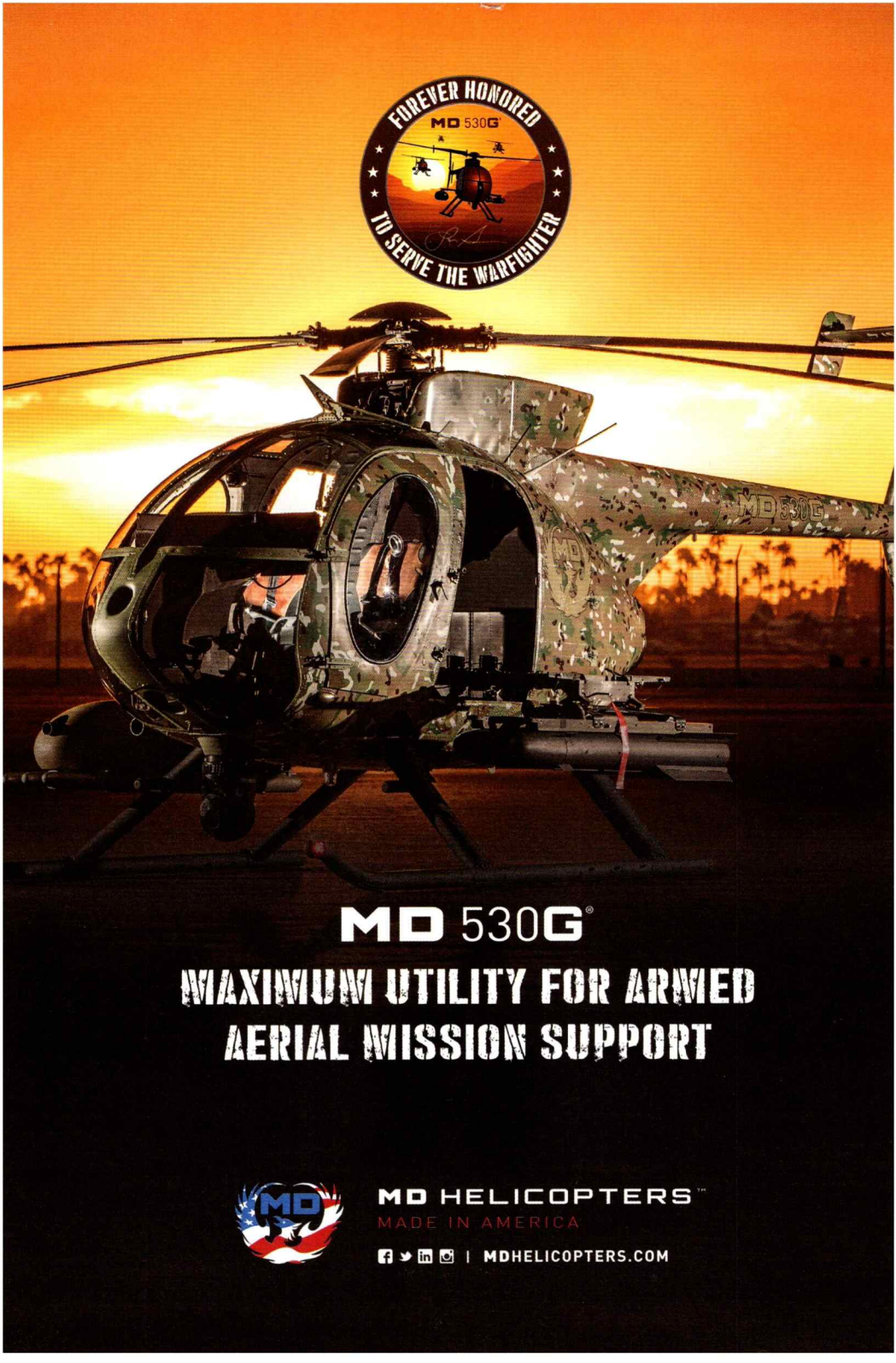
82 Sensor systems
A selection of major EO, radar and sonar systems integrated on military helicopters.

106 Weapon systems
Air-to-air, air-to-ground and anti-ship missiles, guns, launchers, rockets and torpedoes for rotorcraft.

132 Protection systems
A selection of helicopter-mounted self-protection systems.

155 Guide to suppliers
A worldwide listing of companies that supply goods and services to the artillery and air defence sector. Companies are listed with full contact details from p168.

COVER: Soldiers load onto a CH-47 Chinook helicopter before participating in an air assault training exercise at Division Hill, Fort Drum, New York, in February 2018. (Photo: US Army)
ABOVE: A Royal Australian Navy MH-60R Seahawk helicopter during a forward passenger transfer with HMAS *Rankin* inside Cockburn Sound, Western Australia. (Photo: Royal Australian Navy)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Military Helicopter Handbook

Defence Helicopter
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Welcome

After a decade of declining investment in military helicopter programmes, the number of active opportunities across the globe suggests the sector is beginning to return to rude health.

In the US, the FY2019 budget request provided some insight into what the future holds for the world's largest operator of rotorcraft. US Army leaders billed their funding request as a jumping-off point for the FY2020 budget, one they say will contain major changes to acquisition programmes.

For army aviation procurement dollars, several big-ticket items included $1.6 billion for 30 new-build and 50 remanufactured Boeing AH-64 Apaches and $1.1 billion for 56 Sikorsky UH-60 Black Hawks. The service also asked for $148 million to purchase seven aircraft and laid out plans to ramp up production in future years.

The US Army is also asking for industry input for ways to buy the Block 2 MH-47G Chinook for its SOF. In a March 2018 RfI, the service said that it is 'conducting market research' on ways to replace 61 remanufactured MH-47Gs with Block 2 aircraft.

For the Future Vertical Lift programme, while service leaders were at pains to argue that the project is on track, the FY2019 documents lay out potential delays, including postponing an RfP release until FY2021, with a contract award to follow in FY2023.

The army is also expanding its UH-72A Lakota training fleet following Leonardo's retreat over litigation procedures, and has ordered a total of 51 new aircraft from Airbus.

Attention now turns to the USN's trainer requirements. The RfI for an Advanced Helicopter Training System to replace the service's Bell TH-57 Sea Ranger was laid out in 2013. While the RfP was originally anticipated for late 2016, confirmation of requirement details looks to be pushed into 2019.

Elsewhere, OEM estimates suggest that considerable rotorcraft business opportunities remain within Asia-Pacific, with the region likely to see the greatest growth in the near term.

Increasing defence budgets for countries such as China and India are also likely to lead to investment in helicopter procurement. Smaller nations are showing their willingness to make prudent decisions when it comes to modernisation programmes too.

The Republic of Singapore Navy displayed one of its two new Sikorsky S-70B Seahawks at the Singapore Airshow in February 2018. These new Block 2 aircraft have updated avionics software with the capability for a tactical coordination officer to control the nose-mounted EO/IR sensor.

Similarly, the Republic of Singapore Air Force's (RSAF's) fleet of AH-64D Apaches is currently undergoing a series of modifications that include an integrated EW system. Recent developments also indicate that Airbus H225Ms are proving popular in the region, with the RSAF ordering 16 of the type to replace two AS332/532 Super Puma squadrons.

In addition, the Royal Thai Army will order four extra UH-60M Black Hawks, having received Congressional approval for the purchase in 2017. The Philippine Department of National Defense is also on record as publicising the need for its air force to acquire 24 light attack helicopters for counter-insurgency operations.

Like those OEMs with a direct line to the Pentagon, companies with significant footprints across Asia-Pacific may well find it is all to play for.

Tony Skinner, VP Content, *tony.s@shephardmedia.com*

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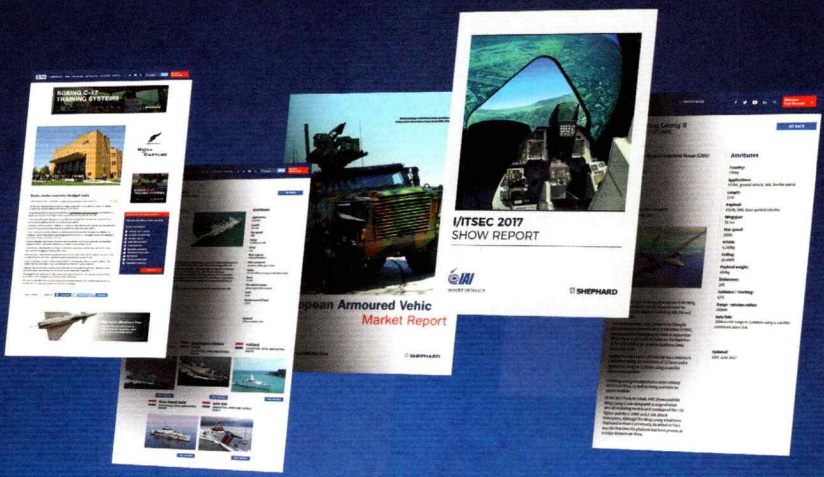

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PLUS

SPECIFICATIONS

ROTORCRAFT

This section describes the main rotorcraft in military service, under development or on offer to military customers. Each aircraft is illustrated with a photograph and specifications including a description of current usage as well as technical data.

Entries appear alphabetically under the principal manufacturer holding design authority, unless otherwise stated.

- **Gross weight:** maximum all-up weight including internal load
- **Empty weight:** weight without fuel, crew, payload or weapons
- **Length:** normally fuselage length, occasionally with rotors running ('overall')
- **Payload:** maximum load either internal or external
- **Max speed:** VNE at sea level
- **Range:** typical sortie, still air
- **HIGE:** hover in ground effect
- **HOGE:** hover outside ground effect

If your company produces a helicopter that you believe should be listed in this section, please contact Karima Thibou at karima.t@shephardmedia.com to ensure it appears in the Shephard Plus online database (shephardplus.com) and is included in the next print edition.

ABOVE: US soldiers perform the preflight checks on an AH-64 Apache in October 2017 before it leaves to Chièvres Air Base, Belgium, in support of Operation *Atlantic Resolve*. (Photo: US Army)

Airbus Helicopters ▸ AS532 AC/AL/SC/UC/UE/UL Cougar

The AS532 UE is the basic version, with a long fuselage and marketed for tactical transport and logistical support missions. SC is a navalised version intended for ASuW and ASW, no longer marketed by Airbus Helicopters. UC is the short utility version for tactical transport and external load carrying. AC and AL are armed versions which can be equipped with pod-mounted cannon, rocket launchers and side-firing cannon. UL is the medium tonnage tactical transport. The first of 12 AS532 AL Cougars was handed over to the Bulgarian Air Force in August 2006, as part of a deal worth $360 million. The AL version has been selected by the Albanian Air Force, to meet NATO requirements, and Georgia. A new version is now available, the H215M (see separate entry). **Applications:** UE – tactical transport and logistical support missions; UC – tactical transport and external load-carrying; AC/AL – armed; UL – tactical transport **Overall length:** 15.53m (short versions), 16.29m (long versions) **Rotor diameter:** 15.6m **Height:** 4.95m **Empty weight:** ranging from 4,365kg (UC) to 4,558kg (SC) **Max load on sling:** 4,500kg **Cruise speed:** ranging from 125kt (SC) to 139kt (UC/AC/UL/AL) **Powerplant:** 2x 1,819shp (take-off power) Turbomeca Makila 1A1 turboshafts **MTOW:** 9,000kg gross **Weapons:** machine guns, cannon and rockets, torpedoes

Airbus Helicopters ▸ AS565 MBe Panther

The AS565 MBe is a medium twin multipurpose helicopter using technologies derived from Airbus Helicopters' experience with the AS365 Dauphin family. It is an all-weather, multirole light rotorcraft designed for operation in severe environments, including hot-and-high conditions, and ship-borne operations, including the maritime security mission spectrum and ASuW. The aircraft design has a large cabin (two crew members and ten passengers) allowing various layout possibilities. Avionics systems include FADEC and VEMD to improve safety and reduce pilot workload. It also includes dual-channel four-axis digital AFCS with SAR modes and glass cockpit technology. The helicopter has a modular mechanical assembly design, with Starflex rotor heads, blades and airframe, and incorporates a Fenestron tail rotor for high manoeuvrability and low external sound levels. The more resistant tail blades are asymmetrically spaced and based on new resin transfer moulding technology. Improvements include an increase of OEI performance with a super contingency rating of 1,129shp during 30s up to three times in the same flight. Search and surveillance capabilities have also been improved with the installation of a FLIR system, multi-mode radar and full NVG compatibility. The AS565 MBe is qualified to operate from over 100 classes of NATO ships, and complies with NATO STANAGs regarding tie-down fittings, fuel hoses and DC/AC electrical connectors. The helicopter's use of a hydraulically activated harpoon with deck-lock securing enables the AS565 MBe to land and take off from ship decks regardless of the wind direction. The Sea Venom/ANL (see separate entry) developed by MBDA is intended to equip the Panther for ASW. In November 2014, PT Dirgantara Indonesia ordered 11 AS565 MBe Panthers, delivered to the Indonesian Navy over three years, for ASW missions. The Mexican Navy has also taken delivery of ten aircraft, with the last examples handed over in December 2017. **Applications:** maritime surveillance, SAR, transport, logistic support, CASEVAC/MEDEVAC, offshore patrol and counter-terrorism **Overall length:** 12.11m **Rotor diameter:** 11.94m **Height:** 3.97m **Empty weight:** 2,406kg **Cruise speed:** 143kt **Range:** 796km (at MTOW) **MTOW:** 4,500kg gross **Powerplant:** 2x 985hp Turbomeca Arriel 2N turboshafts **Weapons:** Stand Alone Weapon System with 20mm cannon, ATG and ATA missiles, rockets or machine guns; AS565 MB weaponry includes anti-submarine torpedoes, 20mm door gun and .50cal sniper rifle for law enforcement missions at sea

Airbus Helicopters ▸ H125M

The H125M is a military version of the civil H125. The H125M is the single-engine, multipurpose 2t version of the Fennec armed aerial scout family. The helicopter has a reduced radar signature through the use of composite materials and low IR-reflective paint. It is tailored for locating and attacking targets of opportunity, with capabilities in hot-and-high environments. **Applications:** armed scout, light utility, training **Cruise speed:** 139kt **Range:** 650km (max weight, sea level, ISA) **MTOW:** 2,250kg, 2,450kg with jettisonable external weapons, 2,800kg with external load **Powerplant:** 847hp Turbomeca Arriel 2D turboshaft with dual-channel FADEC **Weapons:** weapon system with 20mm cannon, air-to-ground/air-to-air missiles, rockets or machine guns

Airbus Helicopters ▸ H135M

The H135M (formerly known as the EC635) is a light utility variant of the EC135 twin-engine, multipurpose 3t helicopter. In addition to two pilots it has seats for up to six passengers. The H135M can be equipped with Safran or P&WC powerplants – both are FADEC-controlled. Technical features include a composite hingeless main rotor head with four composite blades and a Fenestron with asymmetrically spaced blades and sound attenuation chambers in the fin. Avionics options include a glass cockpit and EO sensors. An EW system has the capability to detect, classify, track and indicate incoming laser, radar and missile threats to warn the crew and to activate chaff and flare countermeasures. Modular light armour for cockpit, cabin and cargo compartment can be fitted, along with an EO system and helmet-mounted sight and display for pilot and co-pilot. Its cabin layout allows the H135M to be fitted for missions such as light utility, armed scout, ground fire support, CASEVAC and initial to advanced tactical training. Equipped with the Stand Alone Weapon System, the aircraft can be fitted with 12.7mm machine guns, 20mm cannon pods, 70mm rockets (conventional and laser-guided) or air-to-ground missiles for armed scout or light attack missions. Different types of weapon can be applied to 14in NATO standard lugs; retractable door pintle mounts for machine guns can be installed on both sides of the cabin. By the end of 2015, 98 H135M/H135s were flying for military operators, with an additional 36 in the pipeline. Examples are the German Army Aviation School at Bückeburg, which has been operating 14 H135s since 2000, and the Swiss Air Force which operates 18 H135s and two EC135s for utility and advanced training missions, replacing the SA 316 Alouette III. Other military operators are Brazil, Iraq, Ireland, Jordan, Japan and Spain. In May 2016, Airbus was selected by Ascent as the Aircraft Service Provider for the UK's Military Flying Training System. The contract, worth £500 million over 17 years, covers the provision of 29 H135s and 3 H145s capable of delivering 28,000h/yr. **Overall length:** 12.16m **Fuselage length:** 10.20m **Rotor diameter:** 10.2m **Height:** 3.51m **Empty weight:** 1,462kg **Range:** 630km, 830km with long-range tank (P2e); 615km, 810km with long-range tank (T2e) **MTOW:** 2,950kg, 3,000kg with external load **Powerplant:** 2x 667shp P&WC PW206B2 (P2e) or 634shp Safran Arrius 2B2 (T2e) turboshafts **Seating:** 6 passengers plus 2 pilots **Max speed/VNE:** 140kt **Weapons:** Stand Alone Weapon System with 12.7mm heavy machine gun pod, 20mm cannon pod, 70mm unguided and/or semi-active laser-guided rockets or Ingwe missiles

Airbus Helicopters ▸ H145M

The H145M (formerly known as the EC645 T2) is the military version of the H145 medium-sized (3.7t) helicopter, marketed as a multirole helicopter for military forces. The integration of new Safran engines, four-axis AFCS and Fenestron tail rotor is intended to improve safety and mission efficiency. The H145M's unobstructed main cabin, equipped with a flat floor and two rows of rails, is reconfigurable. The sliding side and rear clamshell doors, along with a high-set main rotor and Fenestron, offer 360° approachability for loading/unloading of armament, passengers or cargo while the rotors are turning. It can seat two pilots and up to ten passengers in crashworthy and foldable seats. Equipped with a generic weapon system, the H145M is fitted with a mission computer, an EO system with TV and IR cameras and laser rangefinder (with designator as needed), a targeting system with helmet-mounted sight and display, two multi-purpose weapon pylons and a choice of weapons load (12.7mm machine guns, 20mm cannon pod, 70mm rockets (conventional and laser-guided) or air-to-ground missiles). This weapon system – combined with the Helionix NVG-compatible glass cockpit, including vehicle and engine management display (VEMD), digital map, video recording, CMA-9000 FMS and data link – provides situational awareness for the crew, while self-protection is provided by armour, self-sealing fuel tanks, and a full EWS suite (radar, laser and missile departure detectors combined with chaff/flare dispensers). In May 2015, the aircraft acheived EASA-certification. The German Armed Forces has ordered 15, with the initial two delivered in December 2015, for special forces missions. The Royal Thai Navy ordered five aircraft with multipurpose pylons offering axial armament capabilities. In May 2016 Airbus Helicopters was selected by Ascent as the Aircraft Service Provider for the UK's Military Flying Training

System. The contract, worth £500 million over 17 years, covers the provision of 29 H135s and 3 H145s capable of delivering 28,000h/yr. Serbia also ordered nine of the type in late 2016, which will be fitted with the HForce weapon system. In March 2017, Airbus announced the integration of the Thales FZ275 LGR, to be deployed with the 12-tube rocket launcher FZ231. **Applications:** special operations, airlift, SAR and CASEVAC/MEDEVAC, armed scout and light attack **Overall length:** 13.63m **Fuselage length:** 11.69m **Rotor diameter:** 11m, tail rotor 1.15m **Height:** 3.95m **Payload:** 1,769kg useful **Cruise speed:** 129kt (at MTOW, sea level) **Range:** 638km; 803km with long-range tank (at MTOW, sea level) **MTOW:** 3,700kg with external load **Powerplant:** 2x 894shp (take-off power) Safran Arriel 2E turboshafts **HOGE:** 8,750ft (MTOW, ISA) **HIGE:** 12,550ft (MTOW, ISA) **Weapons:** proposed weapon fits include 20mm or .50cal HMG pod, ATGMs, 70mm unguided rocket launchers (7 or 12 rounds) and .50cal pintle-mounted HMGs or M134 Dillon machine gun

Airbus Helicopters ▸ H160

Airbus Helicopters unveiled a full-scale model of the H160 medium twin rotorcraft on 3 March 2015 at Heli-Expo. The utility helicopter, the first to be released under the Airbus Helicopters identity, is being developed as a successor to the company's Dauphin family. The H160 has the Airbus Helionix avionics suite and integrates 68 patents, mostly for the Blue Edge main rotor blades, which provide a 50% reduction in sound levels using a double-swept shape. It also increases performance levels with 100kg additional payload compared to conventional blades. The H160 also includes Esterline CMC's CMA-9000 flight management system and CMA-5024 GPS landing system sensor. The canted Fenestron contributes to higher performance levels (40kg increased payload) and a sound level reduction of several decibels. The biplane horizontal stabiliser improves performance levels to permit 50kg additional payload at low speed. The first prototype made its initial flight on 13 June 2015 and was followed by the second on 27 January 2016. First customer deliveries of the H160 are anticipated for 2019. In October 2017, Airbus announced that the third prototype H160, PT3, had completed its maiden flight. Equipped with a cabin interior similar to the eventual serial-production aircraft, it will contribute to flight test and certification activities. Company officials said the third prototype incorporated a significant number of modifications based on feedback resulting from the first two years of testing by development, production and support teams. Airbus Helicopters has so far accumulated over 500 hours of flight testing. According to the company, the H160's new final assembly line at Marignane is almost complete and will be ready to start serial production shortly. In March 2017, the

French MoD announced its intention to incorporate the H160 platform into the forefront of its modernisation programme. Under the Joint Light Helicopter programme, the MoD intends to use the H160 as the replacement for a number of in-service helicopters, including the Alouette III, Dauphin SP and Fennec, with 160 to 190 helicopters expected to be procured. Aiming to be completed as early as 2024, this development signals the platform's first military application. **Powerplant:** 2x Safran Arrano turboshafts **MTOW:** 5.5-6t **Cruise speed:** 160kt **HOGE:** 5,000ft **Seating:** 12 in passenger configuration

Airbus Helicopters ▸ H215M

The H215M (formerly known as the AS532 ALe) is the most recent addition to the Cougar family. It is a medium-weight twin (9t-class), combining the AS532's dynamic and basic assemblies with the avionics and AFCS of the H225M. The Super Puma/Cougar family (more than 800 helicopters delivered) has logged more than 5 million flight hours. Outfitted with a full glass cockpit and modern avionics, the H215M's flight deck is compatible with NVGs. Features include Airbus Helicopters' dual-duplex digital four-axis autopilot and associated AFCS, which provide flight envelope protection, precision and stability. Also incorporated in the instrument panel is the vehicle and engine multifunction display to further enhance flight safety. The H215M can operate in hot-and-high conditions, and has the ability to fly in icing conditions. It has a rugged fuselage that includes high-energy absorption landing gear. Crashworthy seats are installed for the pilot and co-pilot. The fuel tanks are crash-resistant, while multipurpose air intakes provide protection against sand and icing. The H215M can carry a crew of two up to 24 troops for transport missions. It can accommodate six patients on stretchers plus ten other passengers on MEDEVAC flights. Armament qualified for the H215M includes pod-mounted 20mm cannon, 68mm rocket launchers and side-mounted rapid-fire machine guns.
Applications: transport, SAR and CSAR, CASEVAC, fire support **Overall length:** 18.7m **Rotor diameter:** 15.6m **Height:** 4.95m **Empty weight:** 4,610kg **Max load on sling:** 4,500kg **Cruise speed:** 139kt **Powerplant:** 2x 1,877shp Turbomeca Makila 1A1 turboshafts **MTOW:** 9,000kg gross, 9,350kg with external payload **Weapons:** machine guns, cannon and rockets

Airbus Helicopters ▸ H225M

The medium-weight (11t class) H225M (formerly known as the EC725) is the most recent member of the military Super Puma/Cougar family. More than 800 delivered aircraft have amassed more than 5 million flight hours. Technical features include a modular design of mechanical assemblies, the use of composite materials, new avionics, including LCD MFDs, a vehicle monitoring system and digital AFCS. The rotorcraft can be fitted with an integrated EW package. The H225M also incorporates safety features such as redundant dual-channel FADEC, embedded flight envelope limitation in the autopilot and blade shedding technology. The type can be equipped with a full de-icing system compliant with FAR/JAR 29 regulations to fly in severe icing conditions, enabling it to be used as a CSAR/personnel recovery platform and also as an all-weather SAR helicopter. The H225M has logged orders from several armed forces, including Brazil, France, Indonesia, Malaysia, Mexico and Thailand. After the Royal Thai Air Force (RTAF) received four H225Ms, the type conducted its first CSAR demonstration on 22 December 2015. Two additional units have been delivered to the RTAF in 2016. Since 2014, the Brazilian Navy has received seven H225Ms in the multirole utility configuration. The first H225M configured as a naval combat variant is expected to be delivered to the Brazilian Navy in April 2018 after military certification trials. Equipped with MBDA's Exocet AM39 air-to-surface missiles and an indigenous tactical mission system, four other naval combat variants will follow year-on-year through to 2022. The first five of the UH-15B ASuW variant is scheduled for delivery in April 2018 and the last unit will be received in August 2022. **Applications:** CSAR, personnel recovery, utility, all-weather SAR **Overall length:** 19.5m **Rotor diameter:** 16.2m **Height:** 4.97m **Range:** 1,235km **MTOW:**

11,000kg, 11,200kg with external payload **Powerplant:** 2x 2,095hp Turbomeca Makila 2A1 turboshafts **Seating:** up to 28 troops and 2 crew members **Max speed/VNE:** 142kt **Weapons:** cabin-mounted 7.62mm machine guns

Airbus Helicopters ▸ SA 330 Puma

The SA 330 Puma is a utility helicopter originally built for the French Army, French Air Force and UK RAF, now in service with around 34 countries. More than 700 aircraft of the family have logged more than 4.8 million flight hours. No longer marketed by Airbus Helicopters, the Puma is built in Romania as the IAR 330L. The Romanian SOCAT is an upgraded model with an attack helicopter mission system from Elbit. Denel's Oryx is another upgraded Puma developed for the South African Air Force and offered internationally as a utility machine or gunship. The Oryx has Topaz engines optimised for hot, high and dusty conditions, seating two crew and up to 21 troops. Puma SM, the latest standard, is equipped with Makila engines and new avionics and autopilot. In September 2009, the UK announced a £300 million upgrade to extend the life of 24 RAF Pumas by at least another ten years. The first Mk 2 aircraft was delivered to the service in September 2013. In July 2015, the UK MoD awarded Leonardo a €27 million contract to supply its SG200-D radar warning receivers for the Puma fleet. **Applications:** utility **Overall length:** 18.22m **Rotor diameter:** 15.08m **Height:** 4.54m **Empty weight:** 3,615kg **MTOW:** 7,400kg gross **Powerplant:** 2x Turbomeca Turmo turboshafts of various marks **HOGE:** 7,450ft **Max speed/VNE:** 142kt **HIGE:** 7,450ft **Weapons:** machine guns, turreted cannon on SOCAT, rockets, ATGMs

Airbus Helicopters ▸ Tiger HAD

The Tiger attack helicopter was developed for the French and German armies and additionally procured by Spain and Australia with a total of 185 ordered. With its tandem-seat NVG-compatible glass cockpit layout, both the pilot in the forward position and the aft-seated gunner can manage the weapon systems and primary flight controls, switching roles if necessary. The rotorcraft features all-composite airframe and rotors and FADEC-controlled engines with IR suppressors. The German multirole UHT model includes the Osiris mast-mounted sight with second-generation thermal imager, TV camera and laser rangefinder. France's HAD multirole variant, which replaces the previously planned antitank HAC and HAP air-to-air combat and fire support versions, is developed on the basis of the HAP and Australian ARH versions. Deliveries of new Tiger HADs to France began in 2013. On 30 November 2017, Airbus delivered of the first of 36 French HAP/F Standard 1 Tigers upgraded to the HAD/F helicopter (Block 2) configuration. By 2024, the French fleet will be standardised on 67 HAD models. The Tiger HAD provides air-to-ground missile capability, improved target acquisition and ballistic protection, 14% more power, an evolved EW suite and the latest interrogation systems. Avionics incorporated on the HAD are the EUROGRID battlefield management and digital map display systems, integrated radio and satellite communications and data transfer links, an IFF transponder/interrogator, and a high-authority four-axis digital automatic flight control system. The gyro-stabilised roof-mounted sight has a TV camera, thermal imager, laser rangefinder, laser designator and a laser spot tracker capable of simultaneously following up to four targets. Each crew member is equipped with a helmet-mounted sight/display including piloting and firing symbology plus slaving function with either the Strix or a 30mm turret-mounted gun. The Tiger has been combat-proven in Afghanistan, Libya and Mali. Tiger HAD Block 2 helicopters are also 'navalised' allowing operations from ships and in maritime environments. The 135 Tigers built by October 2017 had accumulated more than 92,000 flight hours. **Applications:** attack, ground fire support, escort, armed reconnaissance and air-to-air combat **Overall length:** 15.83m **Rotor diameter:** 13m **Height:** 3.84m **Empty weight:** 4,100kg **Cruise speed:** 146kt **Powerplant:** 2x 1,464shp (take-off power) MTU/Turbomeca/Rolls-Royce MTR 390E turboshafts **MTOW:** 6,600kg gross **Max range:** 740km on internal fuel, 1,130km ferry; 2h 45min standard endurance, 5h max with 2x combat external tanks **Weapons:** typical HAD mission – 2x4 Hellfire or 2x4 Spike air-to-ground missiles; typical escort/combat support load – 30mm turreted gun (5x90 rounds), 2x2 Mistral air-to-air missiles, 2x19 70mm or 2x22 68mm rockets

Airbus Helicopters ▸ UH-72A Lakota

The UH-72A Lakota is a medium-sized, twin-engine US militarised version of the H145, with an NVG-compatible glass cockpit and VEMD. It has a semi-rigid System Bölkow rotor with four glass and carbon-fibre reinforced blades. Clamshell doors and a high tail rotor allow loading from the rear of the cabin as well as via large sliding doors on both sides. Airframe, systems and seating meet civil crashworthiness standards. Modular mission kits are installed so the UH-72A can be used for various utility roles. The UH-72A Lakota was selected in 2006 for the Light Utility Helicopter (LUH) requirement to replace most remaining UH-1s and OH-58A/Cs in US Army and Army National Guard service. It was acquired as a COTS/non-developmental item aircraft that was already FAA type standard certified. The LUH project originally covered the delivery of 345 aircraft from 2006-15 plus five for the USN. The first two Lakotas were delivered in December 2006, with the first examples built at the Airbus Helicopters facility in Columbus, Mississippi, following in September 2007. The army announced in April 2013 that the programme would be reduced to 315. However, in January 2014 Congress restored ten aircraft to the project. In March 2014, the army announced it would buy a further 100 UH-72s in FY2015-16 to replace earlier types in its training fleet. On 15 May 2014, Airbus delivered its 300th UH-72A, and in March 2015 the first initial entry-training helicopter was delivered to the US Army, joining seven Lakotas modified to the training configuration. Army plans call for an initial entry rotary-wing training fleet of 187 Lakotas, made up of a mix of new deliveries and already in-service aircraft reconfigured for the training mission. In November 2015, the US Army exercised contract options worth $65.8 million for 12 additional UH-72As and associated mission equipment packages. In December 2016, a Contractor Logistics Support contract between Airbus and the US Army was signed for a potential five-year maintenance arrangement worth $967 million. The Royal Thai Army has purchased six aircraft through the US FMS programme. The US Army's FY2019 budget request indicates the service's plan to buy 441 UH-72As and in October 2017 Airbus delivered the 400th helicopter to the army. **Applications:** training, utility, CASEVAC **Overall length:** 13.03m **Height:** 3.45m **Empty weight:** 1,792kg **Payload:** 1,793kg useful **Cruise speed:** 133kt (at MTOW) **Range:** 680km; 855km with long-range tank (at MTOW, sea level) **MTOW:** 3,585kg **Powerplant:** 2x 738hp (take-off power) Turbomeca Arriel 1E2 turboshafts **Service ceiling:** 17,200ft (at MTOW) **Seating:** 2 pilots, plus seating for 8 passengers (or 10 passengers in high-density seat configuration) or 2 stretchers and 3 medical crew **Max speed/VNE:** 145kt **Weapons:** none

Avicopter ▸ Z-9

The Z-9 is a licence-built version of the Airbus Helicopters AS365N Dauphin developed by Harbin Aircraft Manufacturing, now part of Avicopter, for the People's Liberation Army. The type made its first flight in 1981 and entered PLA service in 1994. Variants include the Z-9B multirole, the Z-9WE armed helicopter with pylon-mounted armament and gyro-stabilised, roof-mounted optical sight and the Z-9EC for ASW. The cabin of the Z-9WE can accommodate four to six seats for troop transport. According to CATIC, several variants of the Z-9 have been exported to military customers in at least 11 countries including Pakistan, where the Navy operates six Z-9EC variants. In November 2013, the Royal Cambodian Air Force formally accepted the delivery of 12 Z-9s. Other countries known to operate the helicopter are Mali (two Z-9EAs), Mauritania (two Z-9EAs), Laos (two Z-9EAs, two Z-9As), Bolivia (six Z-9EH), Ghana (four Z-9EHs), Namibia (two Z-9EHs), Zambia (seven Z-9EHs), Kenya (nine Z-9WEs on order), and Cameroon (four Z-9WEs). **Applications:** utility, reconnaissance, light attack **Overall length:** 13.72m **Rotor diameter:** 12.01m **Height:** 3.97m **Cruise speed:** 128kt with external weapons **Range:** 528km with standard tank, 20min reserve; 3.5h endurance with standard tank, 20min reserve **MTOW:** 4,100kg **Powerplant:** 2x Turbomeca Arriel 2C turboshafts **Weapons:** antitank missiles, 57mm rocket launcher, 23mm cannon, 12.7mm machine gun; the Z-9EC can carry an ET-52C torpedo

Avicopter ▸ Z-10

The Z-10 is a tandem two-seat attack helicopter developed for the People's Liberation Army by Changhe Aircraft Industries Corp, now part of Avicopter. The 'diamond' fuselage cross-section and blending of the stub-wing roots into the fuselage suggest efforts to reduce the radar cross-section, but the rotor head is exposed and the landing gear is fixed, both features that will produce strong radar returns. The main rotor has five blades, while the tail rotor is mounted scissor-style on the right-hand side of the vertical stabiliser. The horizontal stabiliser is symmetrical, while the lower fin also carries the tail wheel. The slightly forward-swept stub wings appear to have two hardpoints each underneath for large loads and one on each tip, possibly for EW equipment. Some sources estimate that the PLA has received more than 100 Z-10s. The type equips the recently formed PLA Army Aviation aerobatic team. After a January 2015 agreement, three Z-10s were sold to Pakistan and are said to replace its US Cobras. Reports stated that the helicopters were sent to a Pakistani Army base in Qasim/Dhamial for testing, maintenance training and modifications for operating in the Khyber mountains. **Applications:** attack **Overall length:** 14.15m **Rotor diameter:** 13m **Height:** 3.85m **Cruise speed:** 145kt **MTOW:** 7,000kg **Powerplant:** 2x 1,340hp WZ-9 turboshafts **Service ceiling:** 21,000ft **Seating:** 2 **Max speed/VNE:** 160kt **Weapons:** chin turret with 23mm or 30mm cannon, or 30mm or 40mm automatic grenade launcher, or 14.5mm Gatling gun; 4 hardpoints for 57mm or 90mm multi-barrel unguided rocket pods, or up to 8 ATGWs and/or AAMs

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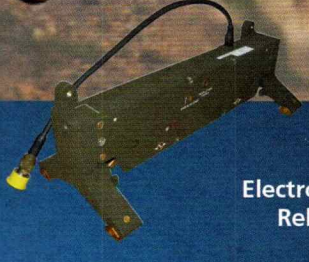

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Avicopter ▸ Z-11/AC301

The AC301 single-engine light utility helicopter was developed by Changhe Aircraft Industries, now part of Avicopter. Under the designation Z-11, it was introduced into Chinese military service in 1998. Roles include reconnaissance and light attack. For export customers, Avicopter offers a choice of WZ-8D or Arriel 2B1A turboshaft engines. Fábrica Argentina de Aviones (FAdeA) signed an agreement with AVIC, and its parent company CATIC, in October 2011 to assemble the Z-11 in Argentina for both domestic and Latin American markets, although it is unknown how many aircraft have been assembled. FAdeA intends to offer customers a choice of engines and avionics. **Applications:** utility, reconnaissance, light attack **Rotor diameter:** 13.01m **Height:** 3.14m **Payload:** 792kg **Cruise speed:** 130kt **MTOW:** 2,250kg **Powerplant:** WZ-8D or Turbomeca Arriel 2B1A turboshaft **Service ceiling:** 17,000ft **Seating:** 1 pilot, 6 passengers **Max range:** 575km Max endurance: 3.43h **Max speed/VNE:** 150kt **Weapons:** 4x HJ-8 ATGMs, 2x 12.7mm machine gun pods or 2x 57mm rocket launchers

Avicopter ▸ Z-15

This 7t-class helicopter is being jointly developed by AVIC as the Z-15 and Airbus Helicopters as the H175. The People's Liberation Army plans to field the Z-15 to replace some of its older utility helicopters. Safran Helicopter Engines and AVIC are developing an alternative engine for the Z-15 which is designated Ardiden 3C by Safan and WZ-16 by AVIC. **Overall length:** 18.06m **Rotor diameter:** 14.8m **Cabin length:** 3.9m **Cabin height:** 1.4m **Cabin width:** 2.01m **Powerplant:** 2x 2,000shp P&WC PT6C-67E turboshafts **Seating:** 16 max

Avicopter ▸ Z-18

The Z-18 is a derivative of the AC313 civil helicopter and is the replacement aircraft for the Changhe Z-8, itself a copy of the French Aérospatiale SA 321 Super Frélon that China imported in the 1970s. The Z-18 includes a redesigned cockpit and is likely to have a similar performance to the 13.8t AC313. It is reported to have new engines, speculatively derived from the WZ-6/Safran Turmo 3C. It also has a glass cockpit, composite rotor blades and images have shown it fitted with a nose-mounted EO turret. So far, three PLA Navy variants of the Z-18 are known to exist: Z-18J AEW; VIP transport; and Z-18F ASW. It was revealed the Z-18F was undergoing trials in August 2014.In January 2015, the aircraft underwent high-altitude testing. (Attributes taken from AC313) **Overall length:** 23m **Rotor diameter:** 18.9m **Cabin width:** 4.6m **Payload:** 4,000kg (internal) **Max load on sling:** 5,000kg **Cruise speed:** 138kt **Range:** 940km (20 min reserve) **MTOW:** 13,800kg **Max speed/ VNE:** 146kt

Avicopter ▸ Z-19/Z-19E

The Z-19 is an armed reconnaissance helicopter developed for the People's Liberation Army. It reportedly made its first flight in 2011 and was publicly revealed in 2012. The helicopter is in service with PLA Aviation regiments where it operates alongside the Z-10 attack helicopter. The Z-19 is a tandem-seat version of the AVIC Z-9W. It is equipped with a nose-mounted FLIR, TV and laser rangefinder, and in 2014 a variant equipped with a mast-mounted radar was observed. It has four underwing hardpoints which can be equipped with a 23mm cannon pod, rocket pods, air-to-air and antitank missiles. To improve survivability some areas are given armour protection and both pilots are provided with crash-resistant seats. The Z-19E is a light armed attack helicopter based on the Z-19 already in service, first revealed in September 2015. It can carry a Blue Arrow 9 air-to-surface missile, TY-90 air-to-air missile, 57mm rocket, 12.7mm HMG pod, and other weapons. The helicopter has a Fenestron tail and is fitted with an integrated avionics system, a fire control system, a communication and navigation system, a digital flight control system, and EW self-protection. It is also equipped with a crashworthy body, bullet-proof seats, bullet-proof tank and other facilities. With a maximum take-off weight of 4,250kg, the Z-19E is designed to attack tanks, armed vehicles and other targets on the ground, providing direct fire support to ground troops. The aircraft can also fly at a very low altitude and fly as part of a convoy of helicopters. In May 2017 the Chinese MoD announced that the Z-19E had successfully completed its maiden flight, carrying out hovering manoeuvres, close ground-effect manoeuvring and low passes to demonstrate its performance. **Applications:** armed reconnaissance **Overall length:** 12m **Rotor diameter:** 11.9m

Height: 4.01m **Cruise speed:** 132kt **Range:** 700km, 4h endurance **MTOW:** 4.5t **Powerplant:** 2x WZ-8A turboshafts (Z-19); 2x WZ-8C turboshafts (Z-19E) **Service ceiling:** 19,700ft **Seating:** 2 **Max speed/VNE:** 150kt **Weapons:** 23mm cannon pod, rocket pods, air-to-air and antitank missiles

AVX Aircraft ▸ JMR

AVX Aircraft proposed a compound helicopter with coaxial rotors, small wings and dual ducted-fan propulsors for the US Army's Joint Multi Role/Future Vertical Lift (JMR/FVL) Technology Demonstrator programme. According to AVX the ducted fans provide the thrust, offloading the rotors, and at 230kt the forward and aft wings and fan ducts together produce 40% of the lift, with 60% coming from the rotors. In August 2014, the US Army announced that it had not selected AVX for the TD phase, leaving the future of its JMR design uncertain. However, in April 2015, the army announced it had extended the technology investment agreement with AVX and the company would now work to mature coaxial compound design, 'focusing on aerodynamic stability, high fidelity computational fluid dynamic analysis and limited wind tunnel testing scheduled for 2015-2017'.

Bell ▸ 206/OH-58 Kiowa/TH-67 Creek

The Model 206 is the basis of a family of light scout and training helicopters in worldwide service. The OH-58A/C Kiowa scout was phased out of US Army service by 2013. The OH-58D Kiowa Warrior (see separate entry) was retired from the armed reconnaissance role in 2016. The Model 406 has been exported to the Royal Saudi Land Forces. A total of 183 TH-67 Creek training helicopters with crashworthy seats and fuel system were delivered to the US Army Aviation Center at Fort Rucker, Alabama from 1993. Under the US Army's Aviation Restructure Initiative announced in 2013, TH-67 has been phased out in favour of the UH-72 Lakota. The TH-57B/C Sea Ranger model is the primary and instrument trainer for the US Navy. Some 30 TH-67s were also delivered to the Republic of China Army. **Applications:** scout, training **Overall length:** 9.5m **Rotor diameter:** 10.15m **Height:** 2.91m **Payload:** 576kg **Range:** 676km **MTOW:** 1,451kg gross **Powerplant:** Rolls-Royce 420shp (take-off power) T63-A-720 (250 C20J) turboshaft **Weapons:** machine guns, rocket pods, 2x Stinger AAMs for US Army OH-58Cs **HOGE:** 8,790ft **Max speed/VNE:** 122kt **Rate of climb at sea level:** 1,180ft/min **HIGE:** 12,790ft

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Bell ▸ 209/AH-1W Super Cobra

Twin-engine attack helicopter developed for the USMC. The Super Cobra was derived from the AH-1T Sea Cobra, replacing a PT6 TwinPac with GE T700 engines, but retained the two-blade main rotor and analogue cockpit. Mid-life update added Night Targeting System that is able to detect, acquire, track, lock on, range and designate targets in day, night and adverse weather conditions. USMC AH-1W helicopters are being upgraded to AH-1Z standard with four-blade main rotor and new avionics (see separate entry). The last AH-1W is expected to be replaced in 2020. Twin-engine Cobras are also operated by the Iranian Army (AH-1J), Taiwanese Army (AH-1W) and Turkish Land Forces (AH-1W). In late 2011, the US approved the sale of three ex-USMC AH-1Ws to Turkey. **Applications:** attack **Overall length:** 17.7m **Rotor diameter:** 14.6m **Height:** 4.44m **Empty weight:** 4,271kg **Range:** 587km **Powerplant:** 2x 2,032shp (take-off power) GE T700-401 turboshafts **MTOW:** 6,700kg **Max speed/VNE:** 170kt **Weapons:** turreted 20mm cannon with 750 rounds, 8x TOW or Hellfire ATGM, 70mm rockets, Sidewinder AAM

Bell ▸ 406/OH-58D Kiowa Warrior

The OH-58D is a modernised scout helicopter with day/night mast-mounted sight, glass cockpit and four-bladed rotor system. T703-AD-700 engine gives hot-and-high performance. 382 OH-58Ds were delivered by mid-1997 under the US Army Helicopter Improvement Program. All models were eventually upgraded to Kiowa Warrior standard with weapons and Multipurpose Light Helicopter kits. The OH-58D has seen action in combat all over the world and is used for long-range day and night target acquisition, multipurpose quick-change kits, and multiple armaments with low IR and acoustic signatures. However, as part of the Aviation Restructure Initiative, driven primarily by the need to save money, the army decided to retire its OH-58D fleet and offer them for sale. The first squadron was inactivated in August 2014 and the last class of OH-58D aviators graduated in September, with the type standing down in September 2017. The Model 406 has been exported to the Royal Saudi Land Forces. Tunisia is receiving 24 excess defence article aircraft under FMS while another country poised to receive OH-58Ds is Greece, which is aiming to induct 70 ex-US Army examples. In April 2017, The Croatian Helicopter Squadron performed the first test flights of its OH-58D Kiowa Warriors, purchased from excess defence stock in 2015. The aircraft were manufactured from 2010 to 2012, and saw operational service with the US Army from 2012 to 2015. **Applications:** reconnaissance **Overall length:** 10.48m **Rotor diameter:** 10.66m **Height:** 3.9m **Payload:** 998kg **Range:** 413km **MTOW:** 2,495kg **Powerplant:** Rolls-Royce 650shp (take-off power) T703-AD-700 (250-C30) turboshaft **Max speed/VNE:** 130kt **Rate of climb at sea level:** 1,355ft/min **Weapons:** US Army OH-58Ds can carry 4x Stinger AAMs, .50cal machine gun with 500 rounds, 4x Hellfire ATGMs or 14x 70mm rockets; Model 406CS carries 4x TOW ATGMs, 2x 20mm cannon pods with 360 rounds, 14x 70mm rockets

Bell ▸ 407AH

Bell's first commercially qualified armed helicopter, the 407AH is configurable for multiple weapon and surveillance packages including miniguns, rocket pods, FLIR and NVG capabilities. Safety features include rupture-resistant fuel system, engine exceedance monitoring and collective mounted throttle. An aircraft survivability equipment suite is available. The 407AH is equipped with the same weapons mounting system as the OH-58D Kiowa Warrior with Alkan rack, standalone Weapons Management System controlling machine gun and rockets, master arm power, weapon select and gun cocking. Weapons options include 70mm rockets with standard M260 lightweight seven-tube rocket launcher and a Dillon Aero M134D Minigun with 3,000-round ammunition box and booster motor. **Applications:** armed missions **Empty weight:** 1,221kg **Payload:** 1,047kg **Range:** 611km **MTOW:** 2,722kg **Powerplant:** Rolls-Royce 250-C47B turboshaft with FADEC **Max speed/VNE:** 133kt **Weapons:** M260 7-tube 70mm rocket launcher, M134D Minigun

Bell ▸ 407GT

The Bell 407GT is the armed version of the Bell 407GX, qualified for a range of weapons from light to advanced laser-guided munitions. The tactical light commercial helicopter brings together the Garmin G1000HTM flight deck with precision weapons capability. Standard specifications include a multi-sensor camera system, weapons management system, universal weapons pylons, tactical radio suite, target sight system, sliding doors for rapid egress and ingress and high-visibility windows for the cockpit and cabin. The latter is configurable for a variety of missions and payloads. Cabin seating for personnel is equipped with weapons and ammunition, providing a single platform for troop insertion/extraction, reconnaissance and close air support. **Applications:** armed missions **Payload:** 1,047kg **Range:** 611km **Powerplant:** Rolls-Royce 250-C47B turboshaft with FADEC **Max speed/VNE:** 140kt **Weapons:** AGM-114 Hellfire; General Dynamics GAU-19/B .50cal machine gun; M260 2.75in 7-tube rocket launcher; HMP-400 machine gun pod

Bell ▸ 412EP/CH-146

The 412EP is a twin-engine medium support helicopter, derived from the Model 212/Twin Huey, produced by Bell in Canada. This model is differentiated visually by its four-blade main rotor. Seating arrangement for 15 including two pilots. Wide opening doors to accommodate a 2t capacity forklift. Features include rupture-resistant fuel cells, energy-absorbing crew seats, collective mounted throttles and Strake and FastFin by BLR, which increases useful load as standard equipment. Dual digital AFCS allows for integration of automatic approach-to-hover and automatic hover capabilities. The type is in military service in about 40 countries. Bell delivered 100 CH-146 Griffons to the Canadian Armed Forces in 1995-1997. In January 2011, Bell Canada received a ten-year, $640 million contract to maintain the fleet until its expected withdrawal from service in 2021. In July 2015 the Japanese MoD selected a Bell-Fuji team to replace the 130 Bell-Fuji UH-1J utility helicopters currently operated by Japan's Ground Self-Defense Force with a new UH-X helicopter based on the 412EPI. Introduced in 2013, the EPI has a glass cockpit based on the Bell BasiX flight deck. In May 2017 it was announced that the Canadian Armed Forces fleet of CH-146 Griffons would be upgraded to include Curtiss-Wright's Fortress 757 cockpit voice and flight recorder technology. An order placed by the Armed Forces of the Philippines in February 2018 for 16 examples was cancelled within days after the Canadian government questioned the uses to which the aircraft would be put. **Applications:** utility, SAR **Overall length:** 12.91m **Rotor diameter:** 14m **Height:** 3.3m **Empty weight:** 3,084kg **Range:** 744km **MTOW:** 5,398kg **Powerplant:** 1,800shp (take-off power) P&WC PT6T-3D TwinPac **Seating:** 2 pilots and up to 13 passengers **HOGE:** 5,200ft **Max speed/VNE:** 140kt **HIGE:** 10,230ft **Weapons:** .50cal/7.62mm machine guns, 70mm rockets

Bell ▸ AH-1Z Viper

The AH-1Z programme is a major upgrade of USMC AH-1W, replacing the existing cockpit and drive system with an integrated digital/glass cockpit, four-bladed, all-composite, hingeless, bearingless rotor system, drive train, engine, transmission, hydraulics, electrical systems and tail boom. The AH-1Z is equipped with a Lockheed Martin/L3 Wescam Target Sight System including a high-resolution FLIR, a dual FoV TV with zoom capability and a laser rangefinder/designator. Pilotage FLIR feeds a Thales TopOwl helmet display while the AH-1Z Viper shares 85% commonality of major components with Bell Helicopter's UH-1Y Venom utility rotorcraft, enhancing deployability and maintainability, while reducing training requirements and the logistical footprint between the two platforms. The first production aircraft rolled out in January 2007 and by August 2008 Bell had delivered ten. The final operational evaluation phase concluded in June 2010 and the type received full-rate production certification in September 2010. The AH-1Z achieved initial operational capability in February 2011 and made its first operational deployment in November 2011 aboard the USS Makin Island. In April 2015, the US government announced that Pakistan had requested an FMS sale of up to 15 AH-1Zs and associated equipment worth up to $952 million and the company subsequently received a contract to supply nine aircraft for delivery by September 2018. This is the first export sale for the type. **Applications:** attack **Empty weight:** 5,579kg **Payload:** 2,812kg **Powerplant:** 2x GE T700 turboshafts **MTOW:** 8,392kg **Max range:** 738km **HOGE:** 16,610ft **Max speed/VNE:** 185kt IRP, 148kt max continuous **Weapons:** stub wings have 2 pylons each capable of carrying a 4-round Hellfire or TOW launcher, 19-tube pod for 2.75in rockets or a single Maverick; tip stations support AAMs such as Sidewinder; chin turret houses 20mm M197 cannon

Bell ▸ Huey II

The UH-1 Iroquois was developed by Bell in the 1950s to meet the US Army's requirement for a medevac and utility helicopter. Following the first production order for the turbine-powered helicopter in 1960, more than 16,000 UH-1s and variants were produced for the US armed forces and more than 65 military customers worldwide. More than 1,400 UH-1s were still in active service in 2017. The Huey II Modernization Program is the only OEM-approved UH-1H performance upgrade available today. The Huey II combines new commercial dynamic components with the Honeywell T53-L-703 engine, leading to an increase in hover performance in hot conditions. The Huey II upgrade increases the maximum gross weight to 4,760kg, while lowering direct operating costs. Along with the Huey II kit installation, Bell refurbishes the UH-1H basic airframe, provides a complete rewire package, updates the avionics and offers a selection of mission-specific kits and customising. According to Bell Helicopter the Huey II has been designed and built with safety in mind, and features include transmission with chip detection and debris collection, rollover bulkheads, rupture-resistant fuel cells, wire-strike protection and jettionsable crew doors. More than 230 Huey IIs are now operating in 13 countries, and in 2013 Bell announced that the fleet had surpassed the 400,000 flight hour milestone. The Yemen Air Force received four Huey IIs in January 2012 and in July Lebanon requested the sale of six helicopters. In 2010, Bell launched a 'production' Huey II line at its Ozark, Alabama facility to enable shorter delivery cycles. This allows it to manufacture 'spec' aircraft to a baseline configuration, which can be customised upon receipt of order to meet specific requirements for direct sale or US FMS customers. **Applications:** utility, CASEVAC, general, EMS, ALE, SAR, fire-fighting

Overall length: 17.4m **Rotor diameter:** 14.6m **Empty weight:** 2,585kg **Payload:** 2,210kg **Max load on sling:** 2,268kg **Cruise speed:** 115kt **Range:** 469km **MTOW:** 4,760kg **Powerplant:** Honeywell T53-L-703 turboshaft **Seating:** 1+13 **Weapons:** door-mounted machine guns

Bell ▸ UH-1Y Venom

Originally planned as a UH-1N Twin Huey upgrade for the USMC, all but the first ten UH-1Ys now use new-build airframes. This new build prevents a 'donor' UH-1N from being taken out of USMC service until a UH-1Y Venom is delivered. The service's objective is to acquire ten remanufactured aircraft and 150 new UH-1Y models. Drive train and four-bladed, all-composite rotor system and core digital avionics are identical to those of the AH-1Z. The commonality of systems and components with the AH-1Z attack platform is estimated to generate an expected saving to the USMC of $3 billion over 30 years. The passive self-defence suite comprises the AN/APR-39A(V)2 radar warning receiver, AN/AVR-2 laser warning receiver and AN/AAR-47 Missile Approach Warning System. Active countermeasures consist of an AN/ALE-47 decoy dispensing system. The first production aircraft rolled out in January 2007 and the Venom achieved IOC on 8 August 2008. The UH-1Y has been deployed to Afghanistan since November 2009. The USMC officially retired its last UH-1N in August 2014 and the final UH-1Y is scheduled to be delivered in 2018. The UH-1Y is a marinised platform designed and manufactured to resist corrosion in maritime environments. It is an expeditionary platform, designed to accomplish missions in almost any environment. It shares 85% commonality of major components with Bell's UH-1Y Venom utility rotorcraft, enhancing deployability and maintainability, while reducing training requirements and the logistical footprint between the two platforms. The US State Department on 11 October 2017 notified Congress of a possible FMS to the Czech Republic of 12 UH-1Ys and an extensive support package, worth $575 million. **Applications:** utility, C2, reconnaissance, CASEVAC, SAR **Empty weight:** 5,246kg

Payload: 3,146kg **Range:** 691km **MTOW:** 8,392kg **Powerplant:** 2x GE T700 turboshafts **HOGE:** 16,610ft **Max speed/VNE:** 160kt IRP speed, 148kt max continuous **Weapons:** LAU-68 (seven-tube) or LAU-61 (19-tube) launchers for 2.75in rockets; Browning-type GAU-16 .50cal machine gun, M240D 7.26 GPMG, GAU-17 7.62mm Minigun; all guns can be fired by crew chiefs, Minigun can also be fixed forward and fired by pilots

Bell ▸ V-280 Valor

Bell revealed the V-280 Valor next-generation tiltrotor design that it is developing for the Joint Multi-Role/Future Vertical Lift (JMR/FVL) Technology Demonstrator (TD) project at the Army Aviation Association of America's Annual Professional Forum and Exposition in April 2013. The US Army announced in August 2014 that Bell would be one of two competitors to proceed to the JMR-TD phase. The FVL is intended to replace the UH-60 in US Army service. The V-280 will be able to undertake long-endurance transport and attack missions. The design builds on the company's experience designing and producing the Bell-Boeing V-22 Osprey tiltrotor. Unlike the V-22, the V-280's two engines will remain in place while the rotors and drive shafts tilt. The aircraft features retractable landing gear and the wings are made of single-piece carbon-fibre. It also has a triple-redundant fly-by-wire control system. With a crew of four, the V-280 will be able to carry 11 combat-equipped soldiers who enter the aircraft through two 1.82m doors on either side of the fuselage. The V-280 will have a cruise speed of at least 280kt, an effective combat range of almost 1,500km, and be able to self-deploy over a distance of 3,890km. Bell is also promising that the V-280 will provide a 'significantly smaller logistical footprint compared to other aircraft'. On 18 December 2017, the V-280 prototype made its first flight. Initial flights will be in the low hover before transitioning to aeroplane mode and expanding the flight envelope in 2018. **Seating:** 4 crew, 11 passengers

Bell-Boeing ▸ V-22 Osprey

The V-22 Osprey is a joint service multirole combat aircraft utilising tiltrotor technology to combine the vertical performance of a helicopter with the speed and range of a fixed-wing aircraft. With its engine nacelles and rotors in vertical position, it can take-off, land and hover like a helicopter. Once airborne, its engine nacelles can be rotated to convert the aircraft to a turboprop aircraft capable of high-speed, high-altitude flight. The Osprey can carry 24 combat troops, up to 9,100kg of internal cargo or 6,800kg of external cargo, at twice the speed of a helicopter. It includes a cross-coupled drive system, so either engine can power the rotors if one fails. For shipboard compatibility, the rotors fold and the wing rotates to minimise the aircraft's footprint for storage. The V-22 is the only vertical-lift platform capable of rapid self-deployment to any theatre of operation, worldwide. The current USMC programme is for 360 MV-22s to perform combat assault and assault support missions and 14 MV-22s for the presidential squadron, while the Air Force Special Operations Command objective is for 54 CV-22s configured for terrain-following, low-level, high-speed flight for long-range special operations. The USN plans to acquire 48 CMV-22B variants for the carrier onboard delivery role. The CMV-22B is similar to the MV-22B with three additions – an extended-range fuel system, an HF radio and a public address system – with deliveries scheduled to begin in 2020. More than 200 V-22s had been delivered by the end of 2017 and current production is 30 aircraft annually. In November 2017, the joint venture announced that the V-22 fleet had surpassed the 400,000-flight hour milestone. Japan became the first export customer for the V-22 with an initial order in 2014 for five aircraft toward a planned total of 17. The first Japanese V-22 was delivered in August 2017. In January 2014, Israel requested an FMS sale of six V-22 Block C aircraft but no order has yet been placed. **Applications:** utility, CSAR, fleet logistics support, special operations **Overall length:** 17.5m **Rotor diameter:** 11.9m **Height:** 6.7m **Empty weight:** 14,430kg **Payload:** 9,100kg of internal cargo, 6,800kg of external cargo **Range:** 2,225km (VTOL), 3,330km (STOL) **MTOW:** VTOL 24,950kg, STOL 27,443kg **Powerplant:** 2x 6,150shp Rolls-Royce T406-AD-400 turboshafts **Seating:** 2 pilots, 2 crew chiefs, 24 passengers **Max speed/VNE:** 300kt dash **Weapons:** ramp gun, underbelly turret gun kit available

Boeing ▸ AH-6i

The AH-6i is designed to meet light attack/reconnaissance needs while maintaining flexibility to integrate future growth. It is a variant of the AH-6M Little Bird operated by US Army special forces, which in turn is based on the OH-6A Cayuse. Boeing announced on 1 May 2014 that the AH-6i had flown for the first time in its production configuration. With a combat-proven design and flexible mission configuration, the AH-6i can carry the highest payload of any aircraft in its class, claims Boeing. Including integrated qualified weapons systems, the platform is designed to be reliable while keeping maintenance costs low. Newly configured, the AH-6i has an integrated digital cockpit leveraging AH-64E software with a colour MFD and integrated digital map. It can be fitted with nose-mounted weapon sights. The AH-6i is powered by a Rolls-Royce 250-C30R/3M engine which develops a power output of 650shp. The engine is controlled by Full Authority Digital Electronic Controller (FADEC). It enables a maximum speed of 132kt. The AH-6i is a candidate to fulfil defence requirements for several potential international customers. A major FMS package to Saudi Arabia announced in 2010 included 36 AH-6i models, and a letter of offer for 24 aircraft was signed with the Saudi Arabian National Guard in 2012. In August 2014, the US awarded Boeing a $234 million FMS contract to supply 24 AH-6is to Saudi Arabia by 31 December 2016. Jordan signed a letter of intent with Boeing in May 2010 to buy 18-24 aircraft. Boeing has developed an optionally manned version known as the H-6U. **Applications:** light attack, reconnaissance **Overall length:** 7.5m **Rotor diameter:** 8.38m **Cabin height:** 1.6m **Cabin width:** 3.3m **Payload:** 907kg **Powerplant:** Rolls-Royce 250-C30R/3M engine **Weapons:** up to 2 Dillon M134 7.62mm Miniguns and 2 7x2.75in rocket pods;

GAU-19 .50cal miniguns, Hellfire missile and laser-guided 70mm rockets

Boeing ▸ AH-64D Apache Longbow

The US Army says the combat-proven D-model Apache is 28 times more effective than the AH-64A and will serve for the next 30 years. Differences from the A-model centre on a millimetre-wave fire control radar, RF Hellfire missiles, a new NVG-compatible integrated cockpit and enhanced digital communications. The new Lockheed Martin Arrowhead pilotage and targeting system is now being fitted, along with an electronic targeting display. The US Army has ordered 649 AH-64Ds – in addition to the 501 remanufactured under two multi-year contracts, Boeing will produce 52 new and 96 remanufactured Longbows. There are approximately 300 international AH-64Ds in production or in service with Egypt, Greece, Israel, Japan, Kuwait, the Netherlands, Singapore, the UAE and the UK. As of September 2017, the Apache fleet in total (all models) had reached 4.3 million flight hours and 1.2 million of these comprise combat flight hours. **Applications:** attack **Overall length:** 17.7m **Rotor diameter:** 14.63m **Height:** 3.59m to top of radome **Empty weight:** 5,352kg **Cruise speed:** 143kt **MTOW:** 10,660kg with max internal and external fuel **Powerplant:** 2x 2,016hp GE T700-GE701C or Rolls-Royce Turbomeca RTM 322 turboshafts **Weapons:** M230 30mm automatic cannon with 1,200 rounds; 16x laser or radar Hellfire missiles; 4x Stinger or Starstreak AAMs or 76x 70mm rockets; will be a major platform for new JAGM **Max range:** 481km on internal fuel **Rate of climb:** vertical rate of climb – 1,650ft/min; max rate of climb – 2,520ft/min **HOGE:** 10,100ft **Max speed/ VNE:** 197kt **HIGE:** 14,300ft

Boeing ▸ AH-64E Apache Guardian

In October 2012, the US Army redesignated the AH-64D Block III as the AH-64E and on 8 January 2013 announced the full designation as the AH-64E Apache Guardian. Army officials said the new designation was warranted by the enhanced capabilities of the Block III upgrade. The first upgraded aircraft was delivered in October 2011 and full-rate production was approved on 24 October 2012. In April 2016, Boeing received a $922 million award to deliver 117 AH-64Es by June 2018. The US Army has stated it plans to acquire 690 AH-64Es, 290 of which are now under contract. The AH-64E includes numerous upgrades: improved digital connectivity; Joint Tactical Radio System; more powerful T700-GE-701D engines; an enhanced transmission with split-torque face gears to accommodate more power; capability to control UAVs; new composite rotor blades; full IFR capability; and improved landing gear. New blades increase the Apache's cruise speed, climb rate and payload capability. Saudi Arabia is seeking up to 70 AH-64Es, while Taiwan has ordered 30. In April 2013, South Korea announced that, following a competitive evaluation, it had selected the AH-64E for a $1.6 billion, 36-aircraft order to replace its existing fleet of AH-1S Cobras. In August 2014, the Indian government approved the purchase of 22 AH-64Es. In January 2015, Boeing was awarded a $295.8 million firm-fixed-price FMS contract for a total of eight AH-64Es for Indonesia. Boeing rolled out the first AH-64E for South Korea on 4 November 2015. In June 2016, Boeing received a $667 million FMS contract to supply 24 AH-64Es to Qatar and in July the UK awarded Boeing a $2.3 billion contract to supply 50 new AH-64Es to replace the British Army's 66 WAH-64D Apaches. In December 2016, the UAE requested a $3.5 billion FMS sale which includes 28 remanufactured AH-64Es and nine new

helicopters. As of September 2017, the Apache fleet in total (all models) had reached 4.3 million flight hours and 1.2 million of these comprise combat flight hours. The Echo Model has flown more than 108,000 of those flight hours. **Applications:** attack **Overall length:** 17.7m **Rotor diameter:** 14.63m **Empty weight:** 5,352kg **Cruise speed:** 143kt **Range:** 481km on internal fuel **MTOW:** 10,660kg with max internal and external fuel **Powerplant:** 2x 1,994shp T700-GE-701D turboshafts **Seating:** 2 **HOGE:** 10,100ft **Max speed/VNE:** 197kt **Rate of climb at sea level:** 2,520ft/min **HIGE:** 14,300ft **Weapons:** M230 30mm automatic cannon with 1,200 rounds; 16x laser or radar-guided Hellfire missiles; 4x Stinger or Starstreak AAMs or 76x70mm rockets

Boeing ▸ CH-47F/MH-47G Chinook

Boeing celebrated the 50th anniversary of the Chinook's first delivery in August 2012. The latest in a long line of US Army Chinooks is the CH-47F. Initially fielded in 2007, the F-model provides increased situation awareness through the Common Avionics Architecture System, enhanced crew safety through the Digital Advanced Flight Control System and reduced maintenance requirements through the machined airframe. The US Army plans to acquire 464 CH-47Fs and on 20 October 2014 it received its 300th aircraft. Boeing delivered the last of 62 remanufactured MH-47G special operations aircraft to the US Army on 14 March 2011. The CH-47F has seen extensive service in Iraq and Afghanistan and is expected to remain the army's primary heavy lift helicopter until 'at least the 2038 time frame'. Numerous export customers have ordered the F-model beginning with the Netherlands, which ordered six in February 2007. The Royal Canadian Air Force received the last of 15 aircraft in June 2014. Australia bought seven, which were delivered in 2015 and in February 2016 announced that it would buy another three. The Italian Army has purchased 16 with an option for another four, and the UK government ordered 14 in 2011. Other customers include Turkey and the UAE. In August 2014, the Indian government approved the purchase of 15 CH-47Fs. In 2015, Boeing delivered 57 Chinooks followed by 49 in 2016. In April 2016, Boeing received a $308 million FMS contract to build 12 CH-47Fs for the Royal Netherlands Air Force and in December 2016, the US government approved a possible $3.51 billion FMS to Saudi Arabia which includes 48 CH-47Fs. Boeing is developing a Block II upgrade for the CH-47F intended to restore 1t of lift lost through the earlier upgrade. On 27 July 2017, the DoD awarded

Boeing a $277 contract million for CH-47F Block II engineering and manufacturing development. Boeing will build three prototypes for testing from 2019 with the first delivery of low rate initial production helicopters expected in 2023. The CH-47F is one of two contenders for Germany's project to acquire 45-60 heavy lift helicopters to replace its CH-53s from 2023 with a contract award expected in 2020. **Applications:** heavy lift, troop transport, CASEVAC **Overall length:** 30.18m including rotors **Fuselage length:** 15.9m **Rotor diameter:** 18.29m **Height:** 5.77m **Cabin width:** 3.78m **Payload:** 10,886kg **Cruise speed:** 170kt **Range:** 370km mission radius **MTOW:** 22,668kg **Powerplant:** 2x 4,777hp Honeywell T55-GA-714A turboshafts **Service ceiling:** 20,000ft **Seating:** 3 crew, up to 55 troops or 24 litter patients and 3 attendants **Weapons:** up to 3 pintle-mounted medium machine guns

Boeing/Leonardo ▸ MH-139

The Boeing MH-139 is based on a fully type-certified FAA FAR Part 29 helicopter, designed for the USAF's UH-1N Huey Replacement Program. It is derived from the Leonardo Helicopters AW139, with the company unveiling its MH-139 on 2 March 2017 at the Air Force Association Air Warfare Symposium. It was later displayed at the AHS Annual Forum and Technology Display. Boeing is working with Leonardo, in the form of AgustaWestland Philadelphia Corporation, which has built about 250 AW139s over the past decade. Boeing and Leonardo have proposed that the MH-139 could potentially save the USAF up to $1 billion in acquisition costs. Although the model will have to be converted from its civil configuration, Boeing has stated that the militarised version of the AW139 will still be cheaper to acquire and less expensive to maintain during its lifecycle. The USAF plans to reach a final decision by June 2018. Specification are for the AW139. **Applications:** general, EMS, ALE, SAR, FF, VIP **Overall length:** 16.65m rotors turning **Fuselage length:** 13.53m **Rotor diameter:** 13.8m **Cabin length:** 2.7m **Cabin height:** 1.42m **Cabin width:** 2m **Empty weight:** 3,300kg **Payload:** 2,900kg (useful load) **Cruise speed:** 167kt **Range:** 1,061km (auxiliary tanks, no reserve) **Powerplant:** 2x 1,680hp (take-off power) P&WC PT6-67C turboshafts **MTOW:** 6,400kg, optional 6,800kg **Seating:** 1-2 pilots + 15 passengers **HIGE:** 15,360ft **HOGE:** 8,130ft

CAIC ▸ Z-11WB

The Z-11WB Kuang (Buzzard) armed reconnaissance and light attack helicopter is the newest variant of the AVIC Z-11 (see separate entry). The aircraft made its first flight in September 2015 and was displayed publicly for the first time at Airshow China 2016 in Zhuhai in November that year. For surveillance and reconnaissance missions the Z-11WB is equipped with an under-nose EO/IR sensor turret, and it can be armed with a variety of weapons. The Z-11WB was displayed at Airshow China with pintle-mounted Norinco LG3 40mm automatic grenade launcher (AGL) and 7.62x54mm CS/LM12 six-barrelled minigun. The weapon pylons on either side of the fuselage were equipped with a quad TL-2 (Tian Lei 2) air-to-surface missile launcher, an AG-300/M air-to-ground missile and SW-6 (Sky Wing 6) air-deployable tactical UAV. Weapons displayed along with the Z-11WB include the Red Arrow 8 (HJ-8) and Blue Arrow 7 (HJ-10) anti-armour missiles, FT-9 and YZ-212D laser-guided bombs, the CM-502KG air-to-surface missile and the TY-90 air-to-air missile. For self-defence, the ZW-11 can be equipped with the KG600 jamming pod and the CLA-01W MIR IR jamming system. **Applications:** reconnaissance, light attack, LE **Payload:** 976kg **Range:** 680km **MTOW:** 2,250kg **Powerplant:** 1x Turbomeca Arriel 2B1A turboshaft **Weapons:** various pintle-mounted machine guns, AGLs; various rockets, missiles and bombs on pylons

Denel Aviation ▸ AH-2 Rooivalk

The AH-2 Rooivalk is a tandem-seat attack helicopter developed by Denel Aviation for the South African Air Force, using SA 330 Puma dynamics. Before defence cuts in the early 1990s the SAAF had planned to field 36 Rooivalks but only 12 were built and which now equip 16 Squadron. It is optimised for NoE operation, by day and night and in bad weather. Low crew workload is claimed due to its flying qualities, glass cockpits with automation, helmet-mounted sight and display system and low vibration. Designed to perform its mission at 8,000ft density altitude. Engines provide increased OEI capabilities, and include intake air filters and IR suppressors as standard. Production was completed and development abandoned after failure to win a Turkish order. Production line turned over to A109 LUH. SAAF Rooivalks conducted their first combat missions as part of the UN force in the Democratic Republic of Congo in November 2013 and the following March South African Defence Minister Nosiviwe Mapisa-Nqakula urged Denel to restart production of the Rooivalk. **Applications:** attack **Cruise speed:** 136kt (antitank configuration) **Range:** 536km, 790km with external fuel tanks **MTOW:** 8,450kg **Powerplant:** 2x 1,730hp (take-off power) Turbomeca Makila 1K2 turboshafts; OEI 30s super contingency rating 2,010hp **Seating:** 2 crew in tandem **HOGE:** max hover ceiling (7,600kg, ISA) 11,000ft **HIGE:** max hover ceiling (7,600kg, ISA) 14,000ft **Weapons:** articulated, dual-feed 20mm cannon; up to 16x Mokopa missiles; up to 76x70mm rockets (FZ 90); up to 4x Mistral AAMs on two outboard stations

Enstrom Helicopter ▸ 480B

The 480B is a light observation and training turbine helicopter designed to provide a combination of performance, safety and low operating costs. The configurable two-to-five-seat cabin is intended to provide visibility and long-term comfort for training personnel. The 480B is in service with the Indonesian National Police, Royal Thai Army and Japan Ground Self-Defense Force. In May 2014, Enstrom announced it had received a contract from the Venezuelan MoD to deliver 16 480Bs over 18 months for training use by the country's navy and air force. **Applications:** light observation, training **Rotor diameter:** 9.75m **Height:** 3m **Cabin length:** 9.1m **Empty weight:** 826kg **Range:** 667km **Powerplant:** 420shp Rolls-Royce 250-C20W turboshaft (rated at 277shp MCP, 305shp for take-off) **MTOW:** 1,361kg **Service ceiling:** 13,000ft **HOGE:** 10,000ft **Max speed/VNE:** 124kt

Enstrom Helicopter ▸ F28F/280FX

The F28F and 280FX are light observation and training helicopters in service with the Peruvian Army and Navy and Venezuelan National Guard. Powered by turbocharged piston engines, these three-seat machines are designed to provide a combination of high performance and low operating costs. A standard throttle correlator helps to provide positive training transfer to larger, more complex, turbine-engined helicopters. **Applications:** light observation, training **Overall length:** 8.93m **Rotor diameter:** 9.75m **Height:** 2.74m **Empty weight:** 712kg **Range:** 483km **MTOW:** 1,179kg **Powerplant:** 225hp Lycoming HIO-360-F1AD 4-cylinder air-cooled turbocharged piston engine **Service ceiling:** 12,000ft **HOGE:** 8,700ft **Max speed/ VNE:** 102kt

HAL - Hindustan Aeronautics ▸ Chetak

The HAL Chetak is the only version of the Alouette III, which first flew in February 1959, that remains in production. It was designed by Sud-Aviation (now part of Airbus Helicopters). HAL has produced around 350 aircraft, including 35 from original knock-down kits which it received from the French manufacturer. The aircraft has been through a number of engine changes during its life. In 2005, the Safran TM 333-2M2 turboshaft replaced the Chetak's original HAL-built Safran Artouste IIIB. This gave the aircraft an important boost in performance, taking its operating altitude up to 21,300ft, which allows it to operate in elevated areas, an important considera- tion for the Indian armed forces, which uses the aircraft in mountainous regions. A Chetak helicopter platform is being used to develop a prototype of a Naval Rotary UAV. **Applications:** utility **Overall length:** 12.89m **Fuselage length:** 10.03m **Rotor diameter:** 11.02m **Cabin length:** 1.82m **Cabin height:** 1.33m **Cabin width:** 1.86m **Empty weight:** 1,200kg **Payload:** 1,000kg useful **Cruise speed:** 100kt **Range:** 500km **MTOW:** 2,200kg **Powerplant:** 563shp HAL-built Safran Artouste IIIB turboshaft **Service ceiling:** 21,300ft **Seating:** 7

HAL - Hindustan Aeronautics ▸ Dhruv

Developed in conjunction with the Advanced Light Helicopter (ALH), the HAL Dhruv is a twin-engined light helicopter designed to meet the requirements of the Indian armed forces. Initially entering service in January 2002, Dhruvs have been delivered in a number of variants with different engines and avionic suites. The Mk 1 went into service with the Indian Coast Guard for SAR operations, followed by service with the Indian Army, Navy, Air Force and Border Security Force. Design and performance was specified to meet India's hot-and-high requirements, with the aircraft landing on 26,000ft high peaks in the Himalayas. Plans to undertake the ASW role were abandoned, but the aircraft operates in utility configuration for the navy. The Indian Army uses the Dhruv for utility and medevac missions. In June 2008, the first major foreign sale was secured when the Ecuadorian Air Force ordered the type. This followed earlier examples delivered to Israel and Nepal. The company is also pursuing sales prospects in a number of countries in Southeast Asia, Africa and South America. More than 200 Dhruvs have been produced and are in Indian service. In March 2017 the Indian cabinet approved the purchase of 16 Dhruvs for the Indian Navy and 16 for the Indian Coast Guard, for delivery from 2020-22 **Applications:** utility **Overall length:** 15.87m **Fuselage length:** 12.89m **Rotor diameter:** 13.2m **Cabin length:** 3.35m **Cabin height:** 1.42m **Cabin width:** 1.96m **Empty weight:** 2,800kg **Payload:** 2,700kg **Cruise speed:** 132kt **Range:** 800km with 20min reserve **MTOW:** 5,500kg **Powerplant:** 2x 1,100shp Turbomeca TM 333 2B2 or 1,200shp Turbomeca Ardiden 1H (co-produced by HAL as the Shakti in India) turboshafts **Seating:** 2 crew, 14 passengers **Max speed/VNE:** 157kt **HIGE:** 9,800ft

HAL - Hindustan Aeronautics ▸ IMRH

HAL unveiled a mock-up of the Indian Multi-Role Helicopter (IMRH) at the Aero India 2017 exhibition on 14 February that year. The twin-engine 10t design is intended to meet the requirements of the Indian Army, Navy and Air Force for a helicopter that can be used in a variety of roles including troop lift, casualty evacuation, CSAR, ASW and ASuW. The helicopter is intended to be capable of operating at altitudes above 21,000ft. The design shown has a five-blade rotor, a four-blade tail rotor, composite fuselage, a glass cockpit, retractable landing gear and large clamshell doors. It will reportedly be powered by a pair of turboshafts delivering 2,500hp each. A prototype will not be ready for four years, with HAL looking to freeze the preliminary design in March 2017 so that it could be built within 18 months. The IMRH is expected to replace India's older Mi-8/17s (see separate entry). HAL estimates that India's armed forces could require as many as 400 IMRHs, and its target is to deliver the first one by 2024. **Overall length:** 18.7m **Rotor diameter:** 18m; 3.7m (tail) **Height:** 5.6m **Payload:** 3,500kg **Range:** 500km **MTOW:** 12,500kg **Seating:** 24 fully equipped troops or 18 persons in the VIP role **Max speed/VNE:** 124kt **Weapons:** gun pods, missiles, rockets, and torpedoes **Range with option fuel:** 800km

HAL - Hindustan Aeronautics ▸ LCH

The Light Combat Helicopter (LCH) is a 5.5-6t class multirole combat helicopter being developed by HAL to meet the requirements of the Indian Army (114 aircraft) and the Indian Air Force (65). The first technology demonstrator (TD-1) made its initial flight at HAL's Helicopter Complex, Bangalore, on 29 March 2010 and TD-2 made its first flight on 28 June 2011. The LCH shares many technical features with HAL's Dhruv Advanced Light Helicopter, including the rotor system, transmission, engine, hydraulics, IADS, weapons system and avionics. Features unique to the LCH intended to make the helicopter lethal, agile and survivable include the narrow fuselage which houses tandem cockpits, crashworthy landing gear, crashworthy and self-sealing fuel tanks, aerofoil-shaped stub wings for weapons, armour protection, NBC protection, and low-visibility features. The LCH will have day/night targeting systems including a helmet-pointed sight and EO pod consisting of a CCD camera/FLIR/laser rangefinder/laser designator. Turret gun slewing is controlled by the gunner's helmet-mounted sight. The LCH is fitted with a self-protection suite consisting of radar/laser missile warning systems and countermeasures dispensing system. In September 2015, HAL announced the completion of hot-and-high altitude trials on its third prototype of the LCH. At the Aero India exhibition in February 2017 HAL officials said the first ten helicopters would be delivered within four months. Sri Lanka has ordered 20 LCHs. **Applications:** attack **Overall length:** 15.84m **Rotor diameter:** 13.2m **Height:** 4.38m **Cruise speed:** 145kt **Range:** 550km **MTOW:** 5.8t **Powerplant:** 2x 1,100shp Turbomeca TM 333 2B2 or 1,200shp Turbomeca Ardiden 1H/Shakti turboshafts **Weapons:** M621 20mm cannon in Nexter THL-20 turret; 70mm rockets

KAI - Korea Aerospace Industries ▸ KUH-1 Surion

The KUH-1 Surion is South Korea's first locally developed utility helicopter. It is intended to replace the Republic of Korea (ROK) Army's ageing fleet of UH-1H and MD 500 aircraft. The first of four prototypes made its maiden flight on 10 March 2010 and deliveries began in December 2012 of an initial 20 helicopters ordered two years before. In December 2013, KAI received a contract to deliver a further 70 helicopters by 2017. South Korea's armed forces are expected to acquire 220 helicopters in the first decade of production. More than 70 aircraft had been delivered by the end of 2017. The KUH-1 can be used for various missions including troop transport, internal and external cargo transport, border patrol and special operations. The Surion has been in operation with the ROK Army since 2012 and the KUH-1P variant, developed for the National Police Agency, has been on surveillance and transportation missions since 2013. In July 2013, KAI was chosen by the Defense Acquisition Procurement Agency (DAPA) to develop an 'amphibious task helicopter system' for the ROK Marine Corps. The MUH-1 made its first flight on 19 January 2015 and the service received the first two of 30 helicopters on 10 January 2018. DAPA selected KAI to develop a dedicated medevac helicopter based on the Surion in August 2014 and a prototype was unveiled at the October 2017 ADEX exhibition. The variant can carry six stretchers and is equipped with a rescue hoist. KAI has proposed additional variants based on Surion such as a naval and fire-fighting version. **Applications:** utility, maritime, medevac, law enforcement **Overall length:** 19m **Rotor diameter:** 15.8m **Cabin height:** 1.51m **Cabin width:** 1.79m **Empty weight:** 4,970kg **Cruise speed:** 140kt **Range:** 430km **MTOW:** 8,930kg **Powerplant:** 2x GE T700-710K turboshafts **Service ceiling:** 14,000ft **Seating:** 2 pilots, 2 gunners and 9 passengers, 16 if no gunners **Weapons:** various missiles, rockets and guns

KAI - Korea Aerospace Industries ▸ Light Armed Helicopter

The South Korean government selected KAI in July 2014 to develop the 4.5t Light Armed Helicopter (LAH) and the related Light Civil Helicopter (LCH). KAI and Airbus Helicopters signed an agreement to jointly develop the types in March 2015. KAI is to develop the LCH based on Airbus Helicopters' H155. The programme hopes to transform the LCH into the LAH, a military rotorcraft with defensive and offensive equipment such as antitank missiles and machine guns. The LAH and LCH are expected to share more than 50 components. Improvements over the H155 will include 'state-of-the-art' gearbox, main rotor blades and cockpit. Development of the LCH is expected to be completed by 2020 and will be followed by the LAH in 2022. The LAH will replace the MD Helicopters MD 500 and Bell AH-1S Cobra attack helicopter fleets in ROK Army service. KAI forecasts local demand for 400 helicopters of both types, with a potential export market for another 600. On 25 June 2015, KAI signed development contracts for the LAH and LCH programmes, propelling both projects forward.
Applications: armed reconnaissance

Kaman Aerospace ▸ SH-2G Super Seasprite

The SH-2G Super Seasprite is an upgraded version of the SH-2F and has Kaman's patented servo flap main rotor control system. The SH-2G(I) variant is a remanufactured and modernised version of the USN aircraft, offering Penguin missiles and an Integrated Tactical Avionics System. Onboard sensors include 360° sea surveillance radar, a third-generation staring focal plane array, FLIR and ESM with automated countermeasures – they are integrated through dual-redundant mission data processors enabling the SH-2G to independently engage surface and submarine contacts. The international variant is an upgrade to the aircraft originally intended for delivery to the Australian government through a contract that was cancelled in 2008. New Zealand subsequently chose to acquire ten ex-Australian SH-2G(I) aircraft to replace the New Zealand Defence Force's fleet of SH-2G Seasprites with a contract signed in April 2013. In October 2014, Peru purchased five of the ex-New Zealand SH-2Gs, four of which will be upgraded by General Dynamics Canada. The first helicopter commenced production flight testing at the company's Bloomfield, Connecticut facility in April 2014 and it is now used for maintenance and aircrew training. Kaman delivered all ten aircraft to New Zealand in 2015. The SH-2G(ASW) version is designed primarily for ASW missions, but is outfitted with other sensors so that it can be used for surveillance and counter-intelligence/insurgency as well. Its primary sensor is a dipping sonar capable of long-range detection of submerged contacts in open oceans or shallow waters. International operators of the SH-2G include the Royal New Zealand Navy whose SH-2G(NZ) can perform ASuW with the Maverick missile. The SH-2G(NZ) uses the APS-143 radar as its primary targeting and navigation sensor, augmented by ESM and FLIR sensors for contact localisation, identification and self-protection. The Egyptian military operates an ASW variant. The SH-2G(E) features an AQS-18(A) dipping sonar for detection and prosecution of submarine contacts. The type is currently going through mid-life modernisation of the sensor and flight control system. Four SH-2G aircraft in USN configuration are operated by the Polish Navy. **Applications:** ASuW, ASW, SAR, special ops, vertical replenishment **Overall length:** 16m **Rotor diameter:** 13.41m **Height:** 4.14m **Payload:** 2,296kg **Max load on sling:** 1,814kg **MTOW:** 6,441kg **Powerplant:** 2x 1,723shp GE T700-GE-401 turboshafts **Weapons:** 2x Mk 46 ASW torpedoes or 2x Mk 50 ALWT, 2x 7.62mm door guns **Max range:** 621km, 5.3h endurance **Max speed/VNE:** 150kt **HIGE:** 17,600ft

Karem Aircraft ▸ TR36TD

Karem Aircraft was one of four contenders for the US Army's Joint Multi-Role (JMR) Technology Demonstrator (TD), which is a precursor to the Future Vertical Lift (FVL) project that will initially replace the UH-60 Black Hawk and AH-64 Apache from the mid-2030s. Karem proposed developing its TR36TD Optimum Speed Tiltrotor (OSTR) for the JMR effort. Karem was not one of the two teams selected by the army in August 2014 to continue to the TD phase. However, in April 2015, the army announced it had extended the technology investment agreement with Karem and the company would now work to fabricate and test subcomponent articles of its OSTR concept, which will include rotor blades and hub components such as actuators, bearings and electronics. These steps are part of a hub integration functionality test to prepare for an expected full-scale wing-rotor ground tie-down test in the future. The TR36TD would feature twin 36ft-diameter variable-speed rotors and existing turboshaft engines, while providing advantages in weight, drive train, aerodynamic efficiency and propulsion efficiency. TR36TD technology enables production versions to attain level flight speeds of 360kt, high sustained manoeuvres, long ranges and higher rates of climb than most jets, while reducing total cost of ownership through low acquisition cost, simplified maintenance, flexible basing and reduced fuel logistics. Karem argues that the OSTR technology had the potential to offer a 'new paradigm' in utility and performance for future US Army rotorcraft and can be scaled across all FVL sizes (10,000lb to more than 200,000lb). The company's design first emerged during the US Army-led Joint Heavy Lift programme where it had offered the TR75 featuring twin 75ft-diameter tilting rotors. Karem leveraged the work it had already carried out designing a commercial OSTR aircraft with

the development of the AeroCommuter and AeroTrain, which have capacities of up to 90 and 180 passengers respectively.

Leonardo Helicopters ▸ AW101

Jointly developed by Westland and Agusta (prior to their merger, now Leonardo), this three-engined medium/heavy helicopter (previously known as the EH101) is used in SAR, CSAR, Utility/Troop Transport, ASW, ASuW, amphibious lift and VIP roles. The utility variant has a rear ramp. A five-bladed main rotor head includes redundant load paths. Composite main and tail rotor blades, windscreens and engine air intakes have de-icing/anti-icing equipment as standard. Active Control of Structural Response smooths vibration. Low noise signature allows use for CSAR and special forces support. The AW101 has a low workload NVG-compatible glass cockpit and fully integrated communications, navigation, avionics and flight and mission management systems. According to the company, paramount to the success of the AW101 is its large, wide-body cabin which has the capability to transport up to 38 lightly equipped troops or carry vehicles. The type has demonstrated its performance on deployed operations in Afghanistan, Bosnia and Iraq. New BERP 4 rotor blades have been used on RAF aircraft. The helicopter can be equipped to perform air-to-air refuelling as demonstrated in 2008. Customers include Canada, Denmark, Italy, Japan, Portugal and the UK. In April 2009, the US DoD announced the termination of funding to acquire 28 helicopters, designated VH-71A, as the new US presidential transport; airframes built to that point were later sold to Canada. The AW101 was selected by the Italian Air Force to meet its CSAR requirement and the first of 15 HH-101 Caesar aircraft formally entered service in late February 2016. In December 2013, Norway signed a contract for 16 helicopters, with an option for another six, to meet its SAR requirement. In November 2017, Leonardo

announced that the first of 16 AW101 helicopters were delivered to the Norwegian Ministry of Justice and Public Security for its all-weather search and rescue programme. The Royal Norwegian Air Force will use them to phase out the Sea King helicopters currently in service. Currently, there are over 210 units ordered worldwide. **Applications:** utility, naval **Overall length:** 22.8m **Rotor diameter:** 18.6m **Height:** 6.66m **Cruise speed:** 150kt **Range:** 1,360km **Powerplant:** 2,520hp GE CT7 turboshafts **MTOW:** 15,600kg **HIGE:** 10,800ft **Weapons:** 4x torpedoes or depth charges, 2x anti-ship missiles for naval variants, machine guns for CSAR variant.

Leonardo Helicopters ▸ AW109M

Leonardo has developed the AW109M based on the experience gained from the AW109 LUH and previous A109 series to meet a range of international customer's specific mission requirements. The eight-seat multirole helicopter has a four-blade, fully articulated rotor, FADEC and glass cockpit. The instrument panel, interior and exterior lighting are NVG-compatible for operations in low light or for increased stealth. A wide range of role equipment and the provision for internal/external weapon systems ensure operational capability for land and naval missions. **Applications:** armed reconnaissance, C2, surface surveillance, maritime security, SAR, MEDEVAC, troop transport and utility. **Overall length:** 13.04m **Rotor diameter:** 11.00m **Height:** 3.5m **Max range:** 948km **Powerplant:** 2x Pratt & Whitney PW206C (Take Off: 2x 640shp) **MTOW:** 3,000kg **Max Speed/VNE:** 168kt **Weapons:** Up to two pintle-mounted 7.62mm machine guns, 12.7mm machine gun, 12.7mm rifle, 12.7 machine-gun pod (250 or 400 rounds), 70mm rocket launchers (7 or 12 tubes), rocket-machine gun pod (3 rockets/70mm, 250 rounds/12.7mm), laser-guided rockets

Leonardo Helicopters ▸ AW119M

The AW119M is a single-turbine utility helicopter with digital avionics and a large unobstructed cabin that permits rapid reconfiguration for a variety of utility and military applications. Four composite main and two tail rotor blades are driven by a PT6 turboshaft. The AW119M features a Garmin G1000HTM integrated cockpit; critical flight information is shown on two large multi-function displays in real time, allowing the highest levels of safety, situational awareness and reduced pilot workload. High power margins enable safe operation in demanding hot and high environments. The AW119M is a suitable platform for training next-generation pilots. **Applications:** surveillance, reconnaissance, threat suppression, troop transport, utility operations and training. **Overall length:** 12.92m **Rotor diameter:** 10.83m **Height:** 3.60m **Cruise speed:** 131kt **MTOW:** 2,850kg **Powerplant:** 1x Pratt & Whitney PT6B-37A (take-off: 1,002shp) **Service ceiling:** 15,000ft **Max range:** 954km (with 688 kg usable fuel-noreserve-@5,000ft); endurance 5h 20min at 5,000ft with 688kg usable fuel and no reserve **HOGE:** 7,300ft **HIGE:** 11,000ft **Weapons:** 7/12/19-tube launcher for 70/80mm rockets; twin 7.62mm machine gun pod; 12.7/20mm machine gun pod; 12.7mm machine gun pod with 3-tube 70mm rocket launcher

Leonardo Helicopters ▸ AW129

The AW129 is tandem two-seat, twin-engined attack helicopter originally developed for the Italian Army and subsequently developed into a multirole combat helicopter, for the Italian Army and for export. Field supportability and low life-cycle cost are emphasised by the company. The ballistically tolerant airframe of the AW129 is crashworthy to MIL-STD-1290. Main rotor controls pass up through the rotor mast for protection. An upgrade took the main rotor from four blades to five. AFCS allows hands-off operation, recovery capability from unusual attitudes, command augmentation in nap-of-the-earth flight and stability augmentation for weapon aiming. Sensors include a FLIR and TV cameras, laser rangefinder/designator, automatic target tracker, video recorder, night piloting FLIR, IHADSS helmet display. Leonardo delivered 60 AH-129A Mangusta (Mongoose, service designation) helicopters to the Italian Army from 1990 and Leonardo has recently upgraded 32 to the more capable AH-129D configuration. In January 2017, Italy's Ministry of Economic Development awarded Leonardo a contract to begin development of the New Reconnaissance and Escort Helicopter for the Italian Army, designed AW249. TAI and Leonardo have developed the T129 (see separate entry) with more powerful engines, dedicated avionics, air-to-air missiles and an increased number of ATGMs to meet Turkish military requirements. **Applications:** attack **MTOW:** 4,100kg **Cruise speed:** 148kt **Range:** 561km **Powerplant:** 2x 825shp Rolls-Royce Gem 2 Mk. 1004D turboshafts **Seating:** two **Weapons:** 8x TOW-2 missiles; 70mm and 81mm rockets; 20mm M197 cannon

Leonardo Helicopters ▸ AW139M

As the military version of the AW139, the AW139M provides multirole land and maritime capability and includes FLIR, self-protection equipment including IR detection and countermeasures, and heavy-duty landing gear. For military missions, the AW139M has a low thermal and acoustic signature and is available with an ice protection system, allowing all-weather operation. The AW139M also includes equipment such as: armoured seats; ballistically tolerant, self-sealing fuel tanks; and an external stores system for carrying gun pods, missiles and air-to-ground rockets. The first of ten AW139Ms for the Italian Air Force was delivered in 2012. In July 2014, Leonardo announced the sale of two helicopters to the Bangladesh MoD for maritime SAR and utility missions, and in August the Armed Forces of Malta became the newest military operator of the AW139 with the delivery of the first of two helicopters. More than 1,000 AW139s had been ordered and more than 900 delivered for civil and military customers worldwide. **Applications:** battlefield support, tactical and troop transport, threat suppression, C2, SAR/CSAR, maritime patrol and homeland security **Overall length:** 16.66m **Rotor diameter:** 13.8m **Height:** 4.98m **Cruise speed:** 165kt **Range:** 1,061km (no reserve, with auxiliary fuel) MTOW: 6,400kg/6,800kg optional **Powerplant:** 2x Pratt & Whitney Canada PT6C-67C (take-off: 2x 1,679shp) **HOGE:** 8,130ft **HIGE:** 15,360ft **Weapons:** provision for full range of weapons including pintle-mounted cabin machine guns and pylon-mounted rocket pods

Leonardo Helicopters ▸ AW149

The AW149, which made its first flight in November 2009, is an 8t-class multirole battlefield helicopter. For combat support roles, the large, unobstructed cabin features large, flat floor space with accommodation for seats, stretchers, mission console and crew-served weapon mounts. Wide doors provide accessibility and rappelling/fast-roping capability. The AW149 is day/night-capable with a single pilot NVG-compatible low-workload glass cockpit. Its advanced, open-architecture mission system enables the integration of customer-specific avionics, mission and weapon systems quickly and cost-effectively, according to the company. The AW149 is designed to be able to operate in high-threat environments. In July 2014, the AW149 was issued military certification by the Italian Directorate of Air Armaments. **Applications:** Battlefield support and troop transport, SAR/CSAR, CASEVAC/MEDEVAC, C2 and SF operations **MTOW:** 8,300/8,600kg **External load:** 2,800 kg Cabin volume: 11.2 m3 **Cruise speed:** 155kt (ISA, SL, MTOW) **Powerplant:** 2x General Electric GE CT7-2E1 (1,980shp class each) with FADEC and 1x APU (60kW)

Leonardo Helicopters ▸ AW159 Wildcat

The AW159 is a twin-engine, multirole, maritime and utility aircraft developed as a replacement for the Lynx family of helicopters. Designated Wildcat by the UK MoD, the AW159 has been chosen by the British Army and Royal Navy to meet maritime combatant and land utility and reconnaissance requirements. Also available to the international marketplace, the platform is designed to provide an upgrade in terms of operational capability compared to other aircraft in its class. The marinised AW159 is equipped with a fully integrated avionics suite, enabling navigation, communication, theatre integration and stores management functionality. Mission sensor options include a 360° radar and active dipping sonar for the naval variant, EO imaging and electronic surveillance measures and an integrated self-defence suite. The Royal Navy has received all 28 AW159s, and the British Army has 34 of the type in service. In July 2014, the company announced the receipt of a £90 million ($127 million) contract to integrate, test and install the Future Anti-Surface Guided Weapon Heavy and Light missile systems onto the navy's AW159s. The first export contract for the type was secured in January 2013 when South Korea ordered eight aircraft, equipped with the Thales Compact FLASH (Foldable Light Acoustic System for Helicopters) dipping sonar, for the Republic of Korea's Navy. The Philippines have also selected the AW159 to meet their naval requirements, and these two aircraft are currently in build. **Applications:** maritime (ASW, ASuW, surveillance) utility, reconnaissance **Overall length:** 13.5m **Rotor diameter:** 12.8m **Height:** 3.73m **Cruise speed:** 142kt **Range:** 466km **Powerplant:** 2x 1,321shp (take-off power) LHTEC CTS800-4N turboshafts **MTOW:** 6,050kg **HOGE:** 4,290ft **Weapons:** anti-ship missiles, 2x torpedoes or depth charges, machine guns

Leonardo Helicopters ▸ AW169M

As the military version of the multirole AW169, the AW169M is a 4.5t-class helicopter designed to perform a range of light utility and armed attack roles, as well as observation and training missions. The type can be customised with a variety of role equipment, including internal and external weapon systems, a defensive aids suite and modular ballistic protection for cockpit and cabin, to fully exploit its multirole capability in a wide range of operating conditions. **Applications:** Troop transport, surveillance and reconnaissance, SF operations, C2, SAR/CSAR and MEDEVAC/CASEVAC **Overall length:** 14.65m rotors turning **Rotor diameter:** 12.1m **Height:** 4.5m **Cabin length:** 2.77m **Cabin height:** 1.32m **Cabin width:** 2.05m **MTOW:** 4,600kg **Powerplant:** 2x P&WC PW210A turboshafts (1,000shp each) **Weapons:** various missiles, rockets, machine guns possible

Leonardo Helicopters ▸ Super Lynx 300

The Super Lynx 300 is the export version of the Lynx helicopter from Leonardo. It is a small-ship helicopter operated by several customers including Malaysia, Oman, South Africa, a North African customer and Thailand. It is the latest production variant of the successful Lynx family of which more than 450 have been built for military operators in 15 countries. Deliveries of the original Lynx began to the UK MoD in 1977. The Super Lynx 300 features CTS800 engines, composite rotor blades and improved tail rotor, avionics and systems. A high main rotor hinge offset contributes to agility. The wheeled undercarriage is supplemented by harpoon deck lock aboard ship. This helps the SL300 to operate from small ships up to Sea State 6. In July 2014, Leonardo received a contract from the Brazilian Navy to upgrade eight Lynx Mk21A helicopters with many elements of the Super Lynx 300, including CTS800-4N engines. The first upgraded helicopter was scheduled to be delivered before the end of 2017 and last by early 2019. In January 2018, the British Army officially retired its Lynx helicopter fleet after almost 40 years in service,. During its career, the helicopter supported British troops on active service in Bosnia, Kuwait, Afghanistan and Sierra Leone. To mark the end of the aircraft's decommissioning from the British Army fleet, the Army Air Corps flew five of the last remaining Lynx airframes from RAF Odiham in Hampshire on a commemorative tour around England. The Lynx is being replaced by the AW159 Wildcat (see separate entry) in British service. **Applications:** maritime **Overall length:** 13.33m **Rotor diameter:** 12.8m **Height:** 3.67m **Empty weight:** 3,530kg **Cruise speed:** 132kt **Range:** 518km **Powerplant:** 2x 1,321shp (take-off power) LHTEC CTS800 turboshafts **MTOW:** 5,330kg gross **HOGE:** 8650ft **Weapons:** 4x Sea Skua anti-ship missiles; 2x torpedoes or depth charges; 7.62mm machine guns

Leonardo Helicopters ▸ SW-4

The PZL-Swidnik (acquired by Leonardo) SW-4 is a light, single-engine helicopter designed and built in Poland. EASA-certified, it seats up to five people including one or two pilots. The conventional structure is made of aluminium alloy using glass-epoxy composite for non-structural fuselage elements. The helicopter has fully articulated rotor systems. All blades are made of glass-epoxy composite. It has a passenger/cargo interior with additional luggage compartment, and is used in training, utility, liaison, patrol and light attack/escort roles. Training options include VFR, day and night flying, IFR compatibility, FDR, NVG and an emergency simulation unit. The Polish Air Force Military Training School operates 24 SW-4s for basic and advanced training. **Applications:** primary and advanced training, surveillance, reconnaissance and troop transport **Overall length:** 10.58m **Fuselage length:** 9.08m **Rotor diameter:** 9m **Height:** 3.14m (tail rotor turning) **Cruise speed:** 111kt max **MTOW:** 1,800kg **Powerplant:** 1x Rolls Royce M250 C20-R2 (SP) (take off: 450shp) **Service ceiling:** 12,795ft (ISA) **Seating:** up to 5 including 1 or 2 pilots **Max range:** 752km (ISA, SL) **Weapons:** guns, rockets, other **HOGE:** 2,690ft **HIGE:** 4,232ft

Leonardo Helicopters ▸ W-3PL

The W-3PL is an upgraded version of the W3A-Sokol, developed for combat support, SAR and attack missions. The W-3PL configuration has been developed from the experience of the Polish Air Brigade in combat missions during the stabilisation of Iraq, with the final version of the helicopter the result of cooperation between the Polish Land Forces, Polish Defence Industry and PZL Swidnik. It is equipped with integrated communication, navigation and armament systems, based on a mission computer, digital data buses and multifunction displays. **Applications:** troop transport, tactical support, threat suppression, SAR/CSAR, surveillance and reconnaissance **Overall length:** 18.79m (rotor turning) Rotor diameter: 15.7m **Overall height:** 5.14m **Empty weight:** 4,322kg **Payload:** 2,078kg **Range:** 730km **MTOW:** 6,400kg **Powerplant:** 2x PZL-10W (take-off: 2x 888shp) **Service ceiling:** 14,600ft (MCP) **Seating:** up to 10 + 2 pilots **Cruise Speed:** 127kt max **Weapons:** 12.7mm machine gun integrated with the observation-targeting head, 23mm cannon pods; S-8/80mm and S-5/57 rockets; 9M32M IR-guided AA missiles; PLATAN airborne minefield sowing

MD Helicopters ▸ 6XX

First announced in 2016 and then publicly unveiled at Heli-Expo in March 2017, the MD Helicopters 6XX represents the next evolution of the MD 500 series and is a redesigned, single-engine aircraft. Enhancements include a Genesys Aerosystems glass cockpit, a four-bladed tail rotor, HTC S411 main rotor blades, a redesigned composite boom and three-axis autopilot. Also proposed is an electronic sliding door and a 'radar cocoon' for improved safety. The company is targeting a MTOW of 2,494kg, a cruise speed of 140kt and maximum dash of 160kt, a 926km range and 4.5h of endurance. The aircraft will be able to carry two crew and six passengers to a service ceiling of 20,000ft. Originally planned for sale to a foreign military, the 6XX is now slated for both the military and civil markets, and is scheduled to be delivered in two to three years, the company said at Heli-Expo in 2017. In terms of some of the design choices evident on the 6XX, the company said it was 'all about power', which was why it had opted for the four-bladed tail rotor and the new HTC main rotor blades. The project follows earlier work the company had carried out to develop the MD 540A, which was unveiled in 2012, for the US Army's Armed Aerial Scout project as well as foreign military operators. However, growth in the capability of the MD 530G saw that aircraft approach the segment that company originally envisioned for the 540, causing the OEM to readjust its focus. **Applications:** scout, attack **Empty weight:** 998kg **Payload:** 1,043kg (useful load) **MTOW:** 2,494kg **Powerplant:** 650shp Rolls-Royce 250-C47E/3 turboshaft **Max speed/VNE:** 160kt **Cruise speed:** 140kts **Service ceiling:** 20,000ft **HIGE:** 15,000ft **Range:** 606km **Seating:** 2 crew + 6 passengers **Weapons:** M134DH 7.62mm 6-barrel mini gun; M260 70mm 2.75in rockets (7 shot pod); laser guided rockers;

GAU-19/B .50cal machine gun; Hellfire II missile system; FN Herstal HMP400 with M3P .50cal machine gun **HOGE:** 13,000ft

MD Helicopters ▸ MD 530F Cayuse Warrior

An evolution of the OH-6 Cayuse light observation helicopter, the MD 530F was initially FAA-certified in July 1985 as the Model 369FF. It is a scout attack helicopter, engineered to operate effectively in hot-and-high environments. Its high-altitude lift capability is achieved by main-rotor blades 6in longer than the MD 500E. The tail boom is extended 8in and the tail rotor blades have been lengthened to provide increased thrust and directional control at high altitudes. The MD 530F has a five-blade fully articulated main rotor, a crashworthy A-frame truss with integral crew seats, high-capacity landing gear and static mast rotor support. The armed MD 530F Cayuse Warrior includes traditional right-hand command, greater networked communications with an integrated dual-mode tactical radio, ballistic armour for crew protection from small arms fire and a self-sealing fuel tank bladder. It is equipped with a Rohde & Schwarz MR600L tactical radio and four-station mission-configurable armament system (MCAS). MD Helicopters has delivered 12 MD 530F scout attack helicopters to the Afghan Air Force (AAF) and retrofitted five MD 530Fs that had been in service with the AAF since 2011 when the US Army awarded it a $186 million Rotary Wing Primary Training Aircraft contract for up to 54 helicopters for use by the AAF. Under an award by the US DoD announced on 11 January 2016, the AAF has added 12 new MD 530Fs with enhanced mission equipment to its fleet adding a fixed forward sighting system and 2.75in rocket capability to the HMP400 pod with M3P .50cal machine gun, alongside its M134DH 7.62mm six-barrel minigun. On 6 September 2017, MDH received from the US Army a five-year, firm fixed-price contract, potentially worth up to $1.385 billion, to provide an estimated 150 armed MD 530

aircraft and support services to FMS customers. The first order covers 30 MD 530Fs for delivery to the AAF by September 2019. **Applications:** Armed scout, light attack, armed trainer **Fuselage length:** 7.28m **Rotor diameter:** 8.38m (main); 1.55m (tail) **Height:** 2.65m **Empty weight:** 722kg **Payload:** 684kg (useful load) **Cruise speed:** 134kt at sea level **MTOW:** 1,406kg **Powerplant:** 650shp Rolls-Royce 250-C30 turboshaft **Seating:** pilot, co-pilot, 2 or 3 passengers **Max range:** 400km at sea level **Weapons:** MCAS, FN Herstal HMP400 pod with M3P .50cal HMG, M260 rocket pod with 2.75in rockets, M134DH 7.62mm six-barrel mini gun. **HOGE:** 14,400ft **Max speed/VNE:** 152kt **HIGE:** 16,000ft

MD Helicopters ▸ MD 530G Scout Attack Helicopter

The MD 530G Scout Attack Helicopter is the newest addition to the MD Helicopters (MDHI) line of light scout attack helicopters, designed for agile deployment with any rotary wing unit, according to the company. It includes increased capacity landing gear and a mission-configurable aircraft system (MCAS). The MD 530G has a five-blade fully articulated main rotor, a crashworthy A-frame truss with integral crew seats, and static mast rotor support. MD 530G mission equipment includes L3 Wescam MX-10D, Harris 7850A, fast rope and Tyler Special Operations Platform, armoured crew protection, and the MCAS weapons mount and support system. This model successfully completed live fire qualification exercises at Yuma Proving Ground, Arizona, in August 2014. On 1 February 2016, MDHI announced that it had been selected to supply six 530Gs to Malaysian Army Aviation. Deliveries are due to begin in June 2018. In December 2017 it was announced that six MD 530Gs would be supplied to Lebanon under a US aid package. **Applications:** C4I, ISR, CSAR, light attack/close air support, cavalry/security missions, armed escort, special operations **Payload:** 816kg (useful) **Cruise speed:** 110kt (max) **Range:** 426km **MTOW:** 1701kg **Powerplant:** 650shp Rolls-Royce 250-C30 turboshaft **Service ceiling:** 16,000ft **Seating:** pilot, co-pilot, 2 or 3 passengers **HOGE:** 14,400ft **Max speed/VNE:** 152kt **HIGE:** 14,400ft **Weapons:** FN Herstal HMP400 with M3P .50cal machine gun, FN Herstal RMP .50cal/2.5in rocket pod, Dillion Aero 134H-D mini gun; guided (Raytheon TALON) and unguided 2.75in rockets, Moog Stores Management System

NH Industries ▸ NH90 NFH

Developed as a multinational programme between France, Germany, Italy and the Netherlands, the European NH90 was designed to meet NATO requirements for multirole capability from a common helicopter. The NATO Frigate Helicopter (NFH) for maritime and utility operations is one of two variants. Operating from shore bases or on surface vessels up to Sea State 5, the NH90 NFH is tailored for both ASW and ASuW. SAR operations can be performed in either of these configurations. It can be equipped with one anti-ship missile and one torpedo simultaneously. The common core helicopter is based on a twin-engine, four-blade main and tail rotor design and incorporates technologies to improve capability and longevity: composite fuselage with twin side doors and rear ramp; composite blades; modular avionic system with glass cockpit; fly-by-wire control with four-axis autopilot; onboard monitoring and diagnostic system. Navigation and ship landing aids enable the NH90 NFH to perform safe landings in all weather conditions, supplemented by a deck lock device.. The traversing system facilitates manoeuvres on deck. By mid-2012, 111 NFHs had been sold: Belgium (four); France (27); Italy (46); the Netherlands (20); and Norway (14). On 27 March 2014, Qatar ordered 10 NFHs. The first three naval customers received NFHs in 2010 for training and the NH90 is operational in France, Italy and the Netherlands. The first Belgian NFH assembled in Germany was delivered in August 2013. Germany has ordered up to 18 NFHs for its navy. Norway has so far taken delivery of six NH90s out of 14 ordered. The French Navy took delivery of its 15th NFH in September 2015, the first to be delivered in the Final Radar Configuration (FRC) standard. NHIndustries is a JV between Airbus Helicopters, Leonardo and Fokker Aerostructures. It holds Military Design Organisation approval for the NH90. Assembly lines are based in Australia (Australian Aerospace, Brisbane), Finland (Patria, Halli), France (Airbus, Marignane), Germany (Airbus, Donauwörth), Italy (Leonardo, Venice) and Spain (Airbus, Albacete). In December 2016, the 300th NH90 production helicopter was delivered to the Spanish Armed Forces. To date, 515 NH90 helicopters have been ordered by military operators in 13 countries, and the global in-service fleet has logged over 120,000 operational flight hours. **Applications:** maritime and utility operations **Overall length:** 19.56m **Rotor diameter:** 16.3m (rotors turning) **Height:** 5.31m **Empty weight:** 6,400kg **Payload:** up to 4,600kg **Cruise speed:** 162kt **Range:** 1,000km **Powerplant:** 2x 2,231shp (MCP) Turbomeca RTM322-01/9 or GE T700/T6E turboshafts **MTOW:** 10,600kg, option for 11,000kg **Weapons:** ASW torpedoes (Mk 46, Stingray or MU90); anti-ship missile (Marte and its evolutions); 7.62mm or .50cal pintle-mounted machine gun

NH Industries ▸ NH90 TTH

Developed as a multinational programme between France, Germany, Italy and the Netherlands, the European NH90 was designed to meet NATO requirements for multirole capability from a common helicopter. The Tactical Transport Helicopter (TTH) for land-based utility and troop lift is one of two versions. The common core helicopter is based on a twin-engine, four-blade main and tail rotor design and incorporates technologies to improve capability and longevity: composite fuselage with twin side doors and rear ramp; composite blades; modular avionic system with glass cockpit; fly-by-wire control with four-axis autopilot and mission aids; specific mission and role equipment; onboard monitoring and diagnostic system. By mid-2012, 442 TTHs had been sold: Australia (46 army); Belgium (four army); Finland (20 army); France (68 army); Germany (80 army, 42 air force); Greece (20 army); Italy (70 army); New Zealand (nine air force); Oman (20 air force); Spain (45 army); and Sweden (13 army in high cabin configuration). On 27 March 2014, Qatar ordered 12 TTHs. On 30 December 2015, the French MoD ordered another six TTHs for delivery in 2017-19, bringing the army's total to 74. The first TTHs were delivered in 2006, and Italy and Germany have deployed the type to Afghanistan. NHI is a joint venture between Airbus Helicopters, Leonardo and Fokker Aerostructures. It holds Military Design Organisation approval for the NH90 and remains the focal point for the programme. Assembly lines are based in Australia (Australian Aerospace, Brisbane), Finland (Patria, Halli), France (Airbus, Marignane), Germany (Airbus, Donauwörth), Italy (Leonardo, Venice) and Spain (Airbus, Albacete). In December 2016, the 300th NH90 production helicopter was delivered to the Spanish Armed Forces. To date, 515 NH90 helicopters have been ordered by military operators in 13 countries, and the

global in-service fleet has logged over 120,000 operational flight hours. **Applications:** utility, troop lift **Overall length:** 19.56m rotors turning **Rotor diameter:** 16.3m **Height:** 5.31m **Empty weight:** 6,400kg **Payload:** up to 4,000kg **Cruise speed:** 162kt **Range:** 1,000km **Powerplant:** 2x 2,231shp (MCP) Turbomeca RTM322-01/9 or GE T700/T6E turboshafts **MTOW:** 10,600kg gross, option for 11,000kg **Weapons:** 7.62mm or .50cal pintle-mounted machine gun or 20mm gun pods

Russian Helicopters ▸ Ansat-U

The Ansat-U is light multipurpose twin-engine helicopter designed and built by Kazan Helicopters. Able to carry up to six fully equipped troops, proposed military roles include training, CSAR, ground support and C2. The first prototype flew on 17 August 1999 and received Russian certification in 2006. Ansat was to be the first production light helicopter with fly-by-wire controls although these plans were later dropped in favour of hydromechanical controls. The dual-control Ansat-U was selected in late 2001 by the Russian MoD as the new basic trainer for the armed forces. Testing was completed in December 2008, and production is under way for the Russian Air Force. For other roles, the Ansat-U can be equipped with an emergency ditching system, a searchlight, a hoist, and fire-fighting equipment. Auxiliary fuel tanks for extended range are also available. **Applications:** training, CSAR, ground support, C2 **Overall length:** 13.77m **Fuselage length:** 11.54m **Rotor diameter:** 11.5m **Cabin length:** 3.5m **Cabin height:** 1.3m **Cabin width:** 1.68m **Range:** 620km **MTOW:** 3,300kg **Powerplant:** 2x P&W/Klimov PW207K turboshafts **Seating:** up to 6 fully equipped troops **Max speed/VNE:** 148kt

Russian Helicopters ▸ Ka-27/28/29

Designed by the Kamov Design Bureau and built by the Kumertau Aviation Production Enterprise, the Ka-27 (export designation Ka-28) entered Soviet service in 1981. It has a co-axial rotor system. The Ka-27 is the basis for a family of helicopters. The Ka-27PL is the main ship-based ASW helicopter of the Russian Navy and is equipped with radar, dipping sonar, sonobuoys and magnetic anomaly detector. Russia's Ka-27PS SAR helicopter is equipped with Osminog radar beacon receiver, search radio compass, life rafts and medical equipment. The Ka-29 is an armed assault transport. More than 260 Ka-27/28/29 helicopters have been built. The Russian Navy is estimated to have about 80 Ka-27s and another 28 Ka-29s in service while Ukraine has about ten Ka-27/29s. Military sales have been made to eight countries: Algeria, China, North Korea, India, Laos, South Korea, Syria, and Vietnam. The chief of Russian Naval Aviation, Maj Gen Igor Kozhin, said on 6 February 2017 that all of the service's Ka-27 helicopters will be upgraded. Russian Helicopters subsequently stated that, once a contract is received, it will upgrade eight helicopters annually although the extent of the upgrades was not specified. **Applications:** ship-based ASW, SAR, assault **Overall length:** 12.25m **Rotor diameter:** 15.9m **Height:** 5.45m **Payload:** 300kg hoisted **Max load on sling:** 5,000kg **Range:** 750km, 1,240km for Ka-28 **MTOW:** 12,000kg **Powerplant:** 2x 2,200shp (take-off power) Klimov TV3-117VMA turboshafts **Seating:** 3 **Weapons:** 1x homing torpedo; 1x torpedo rocket; 10x PLAB 250-120 bombs; 2x OMAB bombs **HOGE:** 3,700m **Max speed/VNE:** 146kt

Russian Helicopters ▸ Ka-31

The Ka-31 is an AEW variant of the Ka-27/28 helicopter that was originally developed in the 1980s to meet the requirements of the Soviet Navy. The Ka-31 was designed at the Kamov Design Bureau and is built by the Kumertau Aviation Production Enterprise. The Ka-31, which can be operated from ships and shore establishments, is in service with the navies of China (nine), India (nine) and Russia. The onboard E-801M Oko solid-state radar can detect aerial targets (including low-level) over land and sea, and surface targets. It provides automatic reporting to ground and shipborne control posts and air defence systems. **Applications:** AEW **Overall length:** 12.25m **Rotor diameter:** 15.9m **Range:** 680km **MTOW:** 12,500kg **Powerplant:** 2x 2,200shp (take-off power) Klimov TV3-117VMA turboshafts **Rate of climb:** 9.5-12m/s

Russian Helicopters ▸ Ka-52 Alligator

The Ka-52 Alligator is a reconnaissance and combat helicopter that can provide battle management coordination and target acquisition for other helicopters for air-to-air, air-to-surface, reconnaissance and radio jamming missions. Serial production started at the end of 2008 with the first two batches, totalling 48, delivered to the Russian Air Force by 2014.The airframe is similar to the Ka-50 except for the two-seat side-by-side cockpit. The design features a co-axial rotor system. The Ka-52 can carry a range of weapons and combat survivability systems, including the Zvezda K-37 ejection system, allowing both pilots to eject simultaneously. The avionics suite consists of a multiplexed, multi-level computer-based system. Observation, search and targeting systems include optical, TV, laser, IR and radar equipment and a helmet-mounted display. All weapons except the gun mounted on the right-hand side of the fuselage are carried on six stub wing-mounted pylons. The Ka-52's two VK-2500 turboshaft engines allow it to operate at altitudes above 16,400ft. It has a static ceiling of 13,100ft, and is able to take-off and land in hot climates and mountainous terrain. The Alligator can also operate in cold climates and icy conditions. The Ka-52 was designed by the Kamov Design Bureau and is built by the Progress Arsenyev Aviation Company. The Russian Air and Space Force (RuASF) added to its inventory 14 newly-built Ka-52s in 2017, bolstering its fleet to over 100 operated by its army aviation branch, equipping six front-line squadrons in addition to one conversion training squadron. Six of these Ka-52s taken in 2017 were delivered to the 55th Independent Helicopter Regiment (IHR) in Korennovsk in the Southern Military District while the remaining eight examples went to the 440th IHR stationed in Vyazma in the Western Military District. In early December 2017, Russian Helicopter announced that deliveries have been fulfilled while on 28 December it was revealed that eight more Ka-52s for the 440th IHR will be delivered in January 2018. The AAC Progress plant has a contract for 146 Ka-52s for the RuASF, with the last of these slated for delivery in 2020. **Applications:** attack, target acquisition, battle management **Overall length:** with rotors turning 16m **Fuselage length:** 13.5m **Rotor diameter:** 14.5m **Height:** 4.95m **Empty weight:** 7,800kg **Payload:** 2,300kg (max weight) **Cruise speed:** 145kts **Range:** 1,080km (ferry) **MTOW:** 10,400kg **Powerplant:** 2x VK-2500 turboshafts **Service ceiling:** 17,000ft **Seating:** 2 pilots **Weapons:** 12x Vikhr supersonic 8,000m range ATGMs; 1x 2A42 30mm cannon with 450 rounds; 80x80mm rockets or 10x122mm rockets; 4x Igla B IR-homing AAMs **Rate of climb:** 15m/s **HOGE:** 13,123ft **Max speed/VNE:** 167kts

Russian Helicopters ▸ Ka-52K

The Ka-52 is designed by the Kamov Design Bureau and built by the Progress Arsenyev Aviation Company. It is a shipborne combat helicopter being developed for the Russian Navy on the basis of the Ka-52 Alligator reconnaissance and combat helicopter in service with the Russian Air Force. It is fitted with foldable rotor blades and outer stub wing panels, and also includes a more resistant anti-corrosive finish. Other systems and avionics deployed on the helicopter have been adapted for naval use. Of the first batch of four examples built for testing and evaluation, the Ka-52K made its maiden flight on 7 March 2015 at the factory airfield of AAK Progress aviation plant in far eastern Russia. Originally intended to be stationed aboard French made Mistral-class amphibious assault ships, the ship contract was terminated in mid-2015 following the Russian annexation of Crimea, casting doubt over the programme's future. In late 2015, Egypt purchased the Mistral-class ships and is in talks with Russia to acquire multiple Ka-52Ks to equip them with. One of the pre-series Ka-52K deck-capable attack helicopters was stationed on board the Russian Navy aircraft carrier Admiral Kuznetsov, which commenced operations in Syria in early November 2016. Under current plans, the Ka-52Ks delivered to front-line squadrons of Russian naval aviation will now instead be based on domestically-designed and built amphibious assault ships. Whether they will be accommodated as adequately as on the Mistral-class ships remains to be seen by at least 2020. In early 2017 the Ka-52K successfully completed the first phase of its naval testing programme, involving two aircraft. **Applications:** naval combat **Fuselage length:** 13.53m **Rotor diameter:** 7.3m **Height:** 4.95m **Cruise speed:** 145kt **Powerplant:** 2x VK-2500 turboshaft engines **Service ceiling:** 17,000ft **Seating:** 2 pilots **Rate of climb at sea level:** 15m/s **Weapons:** 9M120-1 Ataka-1 (AT-9) ATGM; the 9A4172K Vikhr-1 (AT-16) long-range ATGM, 9M342 Igla air-to-air missile, 30mm cannon **Max speed/VNE:** 167kt

Russian Helicopters ▸ Ka-226T

Kamov's Ka-226 is a further development of the company's Ka-26 line of utility helicopters. However, the design has been heavily modernised and the military Ka-226T uses two Safran Arrius 2G1 turboshafts. The Ka-226 made its first flight in 1997. As with all the Ka-26 family, the design includes an open area aft of the cockpit, which can be used to house a number of dedicated mission pods. Several variants of the Ka-226 have been produced, including the Ka-226A, which is the standard utility model. The Ka-226T is designed for operation in remote mountainous conditions and in warm climates in the reconnaissance, targeting and monitoring and cargo transport roles. The type is able to carry seven soldiers. The company has also developed the Ka-226U version, which has dual controls for training. In 2016 Kamov completed the first naval variant with folding blades. After more than a year of negotiations, an agreement was signed in December 2015 that covers the supply of 200 Kamov Ka-226Ts for the Indian Army and Indian Air Force. Hindustan Aeronautics Ltd (HAL) is lead integrator to produce these rotorcraft under a Russian-Indian joint venture. Sergei Chemezov, the head of Rostec, confirmed in April 2017 that Russian Helicopters will built 60 aircraft for India with the remaining 140 to be built by HAL. Deliveries will be spread over a nine-year period. **Applications:** utility, reconnaissance, targeting, monitoring, cargo, transport, training **Overall length:** 13m **Fuselage length:** 8.1m **Rotor diameter:** 13m **Cabin length:** 2.35m **Cabin height:** 1.4m **Cabin width:** 1.54m **Empty weight:** 1,950kg **Payload:** 1,448kg useful **Cruise speed:** 116kt max, 105kt economic **Range:** 620km **MTOW:** 3,400kg **Powerplant:** 2x Safran Arrius 2G1 turboshafts **Seating:** 10 max **HOGE:** 8,100ft **HIGE:** 10,300ft

Russian Helicopters ▸ Mi-8AMTSh/Mi-171Sh

The Mi-8AMTSh (domestic designation)/Mi-171Sh (export designation) is a military transport helicopter developed from the Mi-8MT(domestic)/Mi-17 (export) by the Mil Moscow Helicopter Plant and is built at the Ulan-Ude Aviation Plant. It is designed to carry up to 36 fully equipped assault troops and provide them with fire support. Other missions include CASEVAC, SAR and CSAR. The helicopter can be armed with radio command-guided ATGMs and IR-homing air-to-air missiles, as well as guns and rockets. Defensive aids include exhaust IR suppressors, chaff and flare dispensers, and an omni-directional IR jammer. The helicopter is in Russian service and over the past ten years more than 120 Mi-171Shs have been exported to customers in Southeast and Central Asia, the Middle East, Africa and Europe. The most advanced version for the Russian Air Force is the Mi-8AMTSh-V, which has Klimov VK-2500-03 turboshaft engines, a more powerful TA-14 APU and upgraded avionics. The Mi-8AMTSh-VA Arctic version is intended to operate in the extreme weather conditions of the Arctic and Far North. It was developed with low temperatures and low flight visibility in mind, including during conditions of 24-hour darkness. The helicopter is capable of carrying out flights even when navigation is challenging, for example, if the satellite signal is lost. The first Mi-8AMTSh-VA helicopter was delivered to the Russian MoD in November 2015. In 2013 the Peruvian MoD ordered 24 helicopters through the Russian state exporter Rosoboronexport. Deliveries began in December 2014 and were completed in January 2016.The most recent order was in June 2017 when the Bangladesh MoD bought five Mi-171Sh helicopters to join the 16 reportedly already in service. **Applications:** combat transport, casevac, SAR, CSAR **Overall length:** 18.42m **Rotor diameter:** 21.29m **Height:** 4.76m **Empty**

weight: 7,100kg **Range:** 675km **MTOW:** 13,000kg **Powerplant:** 2x 1,618kW Klimov TV3-117VM turboshafts **Seating:** up to 36 fully equipped assault troops **Max speed/VNE:** 135kt **Weapons:** Shturm V radio-command-guided ATGMs with single (Shturm) and tandem (Ataka) shaped-charge warheads, up to 4 20x80mm rocket pods, door- and cockpit-mounted machine guns, up to 4x twin 23mm gun pods, freefall bombs

Russian Helicopters ▸ Mi-17V-5

The Mi-17V-5 (domestic designation Mi-8MTV-5) is a military transport developed from the Mi-17 (Mi-8MT) medium multirole helicopter. It was developed at the Mil Moscow Helicopter Plant and is built by Kazan Helicopters. The Mi-17V-5 has seating for two to three crew and up to 36 passengers. Ongoing upgrade work includes a new APU, more powerful Klimov engines and modern avionics. The new Safir APU will allow engine starts at up to 19,700ft (previously 13,100ft) and can work for up to six hours on the ground in generator mode. Kazan worked with Honeywell and Canada's Kelowna Flightcraft on a Western avionics suite and with Transas on a Russian equivalent. Earlier versions of the Mi-17 are in widespread military use. The Venezuelan government is acquiring 53 Mi-17V-5s and India ordered 80, with deliveries commencing in 2009. On 29 October 2014, Russian Helicopters delivered the last of 63 Mi-17V-5s which the US DoD bought in three contracts with Rosoboronexport for use by the Afghan Air Force. Russian Helicopters delivered the last batch of Mi-17V-5 military transport helicopters to India, the company announced on 2 February 2016. A total of 151 Mi-17V-5 helicopters have now been delivered to the country. **Applications:** transport **Overall length:** 18.42m **Rotor diameter:** 21.29m **Height:** 4.76m **Empty weight:** 7,100kg **Range:** 675km **MTOW:** 13,000kg **Powerplant:** 2x 2,000shp (take-off power) Klimov TV3-117VM turboshafts **Seating:** two to three crew and up to 36 passengers **Max speed/VNE:** 162kt **Weapons:** 4x 80mm rocket pods each with 20 rockets; 7.62mm machine guns; 4x GSh-23 gun pods

Russian Helicopters ▸ Mi-24P/Mi-35P

The Mi-24P/Mi-35P is a modification of the Mi-24V/Mi-35. It is an antitank, close air support and armed assault helicopter with crew of three and cabin for eight troops. Hind G is a dedicated NBC/reconnaissance variant. The Mi-35M is the latest export variant built by Rostvertol. An upgrade package includes main, tail rotor and transmission components from the Mi-28, a twin-barrelled 23mm cannon in the nose turret, 9-M-114 and/or 9-M-120 anti-armour missiles and Igla air-to-air missiles. Armament: turreted 4-barrel 12.7mm gun (Hind E) or fixed twin-barrel GSh-23-2 or GSh-30-2 cannon (Hind F); 6x hardpoints for rockets, gun pods, air-to-air and antitank missiles, stub wing pylons for 8x Shturm or Ataka antitank missiles and 2x Igla air-to-air missiles; laser-guided and conventional bombs. **Applications:** antitank, close air support, armed assault, NBC/reconnaissance **Overall length:** 18.57m **Rotor diameter:** 17.3m **Height:** 4.25m **Empty weight:** 8,400kg **Range:** 450km on internal fuel **Powerplant:** 2x 2,200shp (take-off power) Klimov TV3-117VMA turboshafts **MTOW:** 11,500kg gross **Seating:** 3 crew and cabin for 8 troops **Max speed/VNE:** 173kt

Russian Helicopters ▸ Mi-26

The Mi-26 is the largest operational helicopter in the world, used for transport and heavy lift of up to 20t of cargo. The helicopter was developed by the Mil Moscow Helicopter Plant and is built by Rostvertol. The prototype first flew in December 1977 and the type entered service with the Soviet Air Force in 1983. More than 320 Mi-26s have been built for civil users and at least 12 military customers. The design features a single eight-blade main rotor and a five-blade tail rotor. It is equipped with a rear loading ramp capable of accepting large vehicles and overhead track-mounted hoists with 2,500kg capacity. It can carry 82 fully equipped troops or 60 stretchers. Russia's ARMS-TASS military news agency reported in February 2014 that a $2.7 billion contract from Algeria for military helicopters includes six Mi-26s to the latest T2 standard which is equipped with the BREO-26 avionics suite, a new digital autopilot and navigation system and a glass cockpit equipped with five multi-functional LCDs. Russian Helicopters is upgrading Russian Air Force Mi-26s as well as building 22 new helicopters to the latest standard. **Applications:** transport and heavy lift **Overall length:** 40m **Fuselage length:** 35.9m **Rotor diameter:** 32m **Height:** 8.15m **Cabin length:** 12.1m **Cabin height:** 3.17m **Cabin width:** 3.29m **Empty weight:** 28,600kg **Payload:** 20,000kg internal or external **Max load on sling:** 20,000kg **Range:** 800km, 1,920km with additional fuel tanks **Powerplant:** 2x 10,000shp (take-off power) ZMBK Progress D-136 turboshafts **MTOW:** 56,000kg **Service ceiling:** 15,000ft **Seating:** five crew members and up to 82 troops or 60 stretchers **Weapons:** usually unarmed **HOGE:** 5,577ft **Max speed/VNE:** 160kt

Russian Helicopters ▸ Mi-28NE Night Hunter

The Mi-28NE is the export version of the Mi-28N attack helicopter developed for the Russian Air Force. Deliveries to the service began in 2006 and are expected to continue for several years. It has a 24-hour/adverse weather combat capability and high power-to-weight ratio. The five-bladed main rotor has composite blades with swept tips and full articulation via elastomeric bearings attached to a machined titanium head. A scissor tail rotor has two pairs of blades superimposed in a flattened X configuration. Stepped tandem cockpits have flat, armoured glass. Cockpit armour (titanium and ceramic) protects crew from 12.7mm API and unspecified 20mm rounds. Structure, landing gear and seats are crashworthy, and the fuel system is self-sealing, crashworthy and explosion-resistant. The crew wear parachutes for high-altitude escapes; doors and stub wings are jettisoned; and an under-sill airbag inflated before the crew jumps. AFCS allows automatic NoE flight at night and in adverse weather at altitudes down to 16ft. Unlike the original Mi-28, which was configured for a pilot in the rear seat and a navigator/weapons operator in the front seat, the Mi-28NE is offered with a dual control system to facilitate pilot training. The area of the flight instructor's cockpit has been increased, with a larger canopy and changes to the configuration of the energy-absorbing seats. The first three of 19 Mi-28NEs ordered by Iraq in 2012 were delivered in mid-2014. The Mi-28NE was developed by the Mil Moscow Helicopter Plant and is built by Rostvertol. The company announced on 16 March 2016 that serial production of the Mi-28NE combat helicopter with dual controls has commenced, after completing testing at the end of 2015. The dual controls will allow operation of the helicopter by both pilot and operator pilot acting as instructor. **Applications:** attack **Overall length:**

17.05m **Rotor diameter:** 17.2m **Height:** 3.85m **Empty weight:** 7,890kg **Payload:** 2,400kg **Cruise speed:** 145kt **Range:** 450km **MTOW:** 12,100kg **Powerplant:** 2x 2,200shp Klimov TV3-117VMA turboshafts **Service ceiling:** 16,400ft **Seating:** 2 **Max speed/ VNE:** 162kt **Range with option fuel:** up to 1,087km with drop tanks **Weapons:** NPPU chin turret for 2A42 30mm cannon with 250 rounds or 2x UPK-23-250 pods with 23mm GSh-23L gun (250 rounds), 8x 9-M-114 Shturm, 8x 9M-120 Ataka radio command-guided ATGMs, Igla 80x80mm C-8 rockets or 20x130mm C-13 rockets, KMGU-2 mine dispensers

Russian Helicopters ▸ Mi-28UB

Russian Helicopters unveiled the Mi-28UB helicopter at the International Aviation and Space Salon (MAKS 2013). The Russian Ministry of Defence (MoD) plans to acquire up to 60 Mi-28 UB helicopters for the Russian Air Force by 2020. The new helicopters will complement the Air Force command units that typically operate the Mi-28NE Night Hunter (see separate entry). The Russian MoD signed a contract with Russian Helicopters for 24-Mi-28UB helicopters in April 2016. On 22 August 2017, Russian Helicopters announced the completion of the first batch of Mi-28UBs. The aircraft are currently undergoing user acceptance testing. A combat training variant of the Mi-28NE Night Hunter helicopter, the Mi-28UB is designed for flight instruction and for training flight personnel. The system has dual hydromechanical flight controls that can be operated from tandem cockpits, a more spacious lower cockpit to house a flight instructor, a wider pilot canopy, and new energy-absorbing crew seats. Whilst it serves as a trainer it can also perform attack helicopter tasks, performing search-and-destroy missions against land-based targets, small naval vessels and low-speed aerial targets by day or night and in all weather conditions. The Mi-28UB's dual control system allows the aircraft to be piloted from both command cockpit and the operator's cockpit. A number of other improvements have been made, including enhanced ergonomics and energy-attenuating seats with improved characteristics that can absorb shock energy in case of crash landing. Airborne avionics and communication tools have also been improved, increasing the helicopter's reliability, safety and performance specifications. **Cruise speed:** 146kt **Powerplant:** 2x 2,700 VK-2500 turboshaft engines integrating a new full authority digital control system **Service ceiling:**

18,300ft **Weapons:** NPPU chin turret for 2A42 30mm cannon with 250 rounds or 2x UPK-23-250 pods with 23mm GSh-23L gun (250 rounds), 8x 9-M-114 Shturm, 8x 9M-120 Ataka radio command-guided ATGMs, Igla 80x80mm C-8 rockets or 20x130mm C-13 rockets, KMGU-2 mine dispensers **Max speed/ VNE:** 162kt

Russian Helicopters ▸ Mi-35M

The Mi-35M combat helicopter is the most advanced modernisation of the Mi-24V. Designed for day and night combat missions, the Mi-35M includes: an NEI-24 navigation system; a GOES-342 gyro-stabilised EO system within its OPS-24 observation-sighting system; and a PrVK-24 sight. The helicopter is optimised for operations with NVGs. A new rotor system has: composite main blades; new main rotor hub with elastomeric hinges, not requiring lubrication; and a four-blade tail rotor with two-layer X-shape location of blades and torsional suspension. Indonesia acquired four, and in 2008, the Mi-35M was selected to meet a Brazilian Air Force requirement, with 12 helicopters ordered. Iraq received the first four of 24 Mi-35Ms on order in November 2013 and a further four were delivered in May 2014. In December 2014, Rosoboronexport announced it had completed the long-awaited delivery of the last three Mi-35Ms for the Brazilian Air Force. In August 2015, Pakistan inked a contract for four Mi-35Ms for its army as part of a comprehensive effort to provide better close air support for counterinsurgency missions. The Mi-35M was developed at the Mil Moscow Helicopter Plant and is built by Rostvertol.
Applications: day and night combat **Overall length:** 18.57m **Rotor diameter:** 17.3m **Height:** 4.25m **Empty weight:** 8,360kg **Payload:** 2,400kg **Cruise speed:** 140kt **Range:** 460km **MTOW:** 11,500kg **Powerplant:** 2x Klimov VK-2500-02 turboshafts **Service ceiling:** 17,700ft **Max range:** up to 1,000km with drop tanks **Max speed/VNE:** 162kt **Weapons:** turreted twin-barrel GSh-23L cannon; 6x hardpoints for rockets, gun pods, air-to-air and antitank missiles; stub wing pylons for 8x Shturm, 8x Ataka antitank missiles and 2x Igla air-to-air missiles; laser-guided and conventional bombs

Russian Helicopters ▸ Mi-38

Russian Helicopters' Mi-38 medium-lift helicopter is designed to compete with the Leonardo AW101 and Sikorsky S-92 in both the civil and military markets. The first of four prototypes flew for the first time on 22 December 2003 and the second prototype, powered by Pratt & Whitney Canada PW127TS engines, made its first flight in December 2010. In 2012, the second prototype set five world records. The multirole Mi-38 can carry cargo and passengers and can also be used as a SAR helicopter and flying hospital, as well as for offshore missions. The Mi-38 can operate in a range of climates, including maritime, tropical and cold environments. According to Russian Helicopters, the technical solutions deployed in the Mi-38 give the helicopter superior maximum payload, passenger capacity and key performance indicators to other helicopters in its class. The third prototype of the Mi-38, fitted with Klimov TV7-117V engines, made its first flight on 29 November 2013. The fourth prototype, the final version before the helicopter entered serial production, first flew in October 2014. Assembled at the Kazan Helicopter Plant, this prototype differs from the third in having a shock-resistant fuel system by Aerazur and larger window openings. The company announced on 31 December 2015 that the Mi-38 had received type certification from the Federal Air Transportation Agency, confirming compliance with international and Russian aviation requirements; it has been designed to Russian AP-29 standards, which equate to CS-29 standards in Europe and FAR-29 in the US. Certification cleared the way for the helicopter's serial production to commence in 2016. Kazan Helicopters, part of Russian Helicopters, has started assembling the first prototype of the Mi-38T. Russian Helicopters announced in August 2017. Under the terms of its contract with the Russian MoD, Kazan will supply two Mi-38T helicopters for testing and evaluation before the end of 2019. The Mi-38T is a militarised version of the Mi-38, developed by Mil Moscow Helicopter Plant. It has a fuel system with explosion protection and additional tanks to increase flight range. It will also have new communications systems and equipment for maritime rescue operations. **Powerplant:** 2x Klimov TV2-117V or 2x Pratt & Whitney Canada PW127TS engines **Overall length:** 19.95m excl rotor **Rotor diameter:** 21.2m **Cabin length:** 8.9m **Cabin height:** 1.8m **Cabin width:** 2.3m **Payload:** up to 6,000kg inside the cabin, up to 7,000kg on sling **MTOW:** 16,200kg **Max speed/VNE:** 173kt **Cruise speed:** 159kt **Service ceiling:** 19,685ft **HOGE:** 10,170ft **Max range:** 920km, 1,550km ferry range with auxiliary tanks **Seating:** 2 pilots + up to 30 passengers

Russian Helicopters ▸ Mi-171

The multipurpose Mi-171 is an extensive upgrade of the Mi-8, the most widely deployed helicopter type in the world and one of Russian Helicopters' most successful designs, having amassed 100 million flying hours. The Mi-171 has been exported to more than 30 countries. Removal of the clamshell rear doors allows carriage of outsized cargo. Roles include: transport of up to 37 troops in full equipment on troop seats; transport of 26 people on passenger seats; transport of up to 4,000kg of internal cargo; transport of up to 4,000kg on external sling; SAR; and transport of up to 12 casualties on stretchers, accompanied by medical staff. In June 2015, deliveries began for seven Mi-171s to Bangladesh's military under the terms of a US$1 billion loan agreed in 2013. **Applications:** transport of troops; passengers; cargo, SAR and transport of casualties plus medical staff **Overall length:** 18.42m **Rotor diameter:** 21.29m **Height:** 4.76m **Empty weight:** 7,100kg **Payload:** 4,000kg of internal cargo **Max load on sling:** 4,000kg **Range:** 675km **MTOW:** 13,000kg **Powerplant:** 2x 2,200hp Klimov TV3-117VM turboshafts **Max speed/VNE:** 135kt clean

Sikorsky ▸ CH-53D Sea Stallion

The twin-engined CH-53A (S-65) Sea Stallion was developed from 1960 to meet a USMC requirement for a heavy-lift helicopter, entering service in 1966 and was followed by the improved CH-53D, which first flew in 1969. Sea Stallion variants were acquired by the USMC (CH-53A and CH-53D for heavy lift), USN (RH-53A and RH-53D for AMCM) and USAF (HH-53 for CSAR). CH-53 export variants remain in service in Germany, Iran, Israel and Mexico and were previously operated by Austria. In 2016, Airbus Helicopters upgraded the last four of an initial 40 German CH-53G/GS helicopters to CH-53GA standard, and in February 2017 received a contract to upgrade the remaining 26 German CH-53G/GSs to extend their service lives until at least 2030. The Israeli Air Force updated its 23-strong fleet to the Yasur 2000 standard and is now upgrading aircraft to the Yasur 2025 configuration, which includes new EW equipment, communications and obstacle-avoidance systems. It has since reported that the rotorcraft is more functional than it's intended replacement, the MV-22 Osprey. **Applications:** heavy lift **Overall length:** 20.1m **Rotor diameter:** 21.7m **Height:** 7.2m **Empty weight:** 10,708kg **MTOW:** 19,051kg **Powerplant:** 2x 3,925shp GE T64-GE-413/416 turboshafts **Max speed/VNE:** 131kt **Range with option fuel:** 1,070km **Weapons:** CH-53D - .50cal or 7.62mm door and ramp guns

Sikorsky ▸ CH-53E Super Stallion

The CH-53E (S-80) Super Stallion is a three-engined heavy-lift helicopter, derived from the CH-53D, which entered service with the USMC (170 built) as a replacement for earlier models. Other design changes include the addition of a seventh main rotor blade and a tail rotor canted 20°. The CH-53E is due to be replaced in USMC service by the CH-53K from FY2019. An AMCM variant, the MH-53E Sea Dragon, was developed for the USN. The CH-53E is due to start being phased out in favour of the CH-53K by 2020. **Applications:** heavy lift **Overall length:** 22.4m **Rotor diameter:** 24.08m **Height:** 8.57m **Empty weight:** 19,009kg **MTOW:** 33,339kg **Powerplant:** 3x 4,380shp GE T64-GE-416A turboshafts **Max speed/VNE:** 150kt **Range with option fuel:** 889km without refuelling, indefinite with refuelling **Weapons:** .50cal or 7.62mm door and ramp guns

Sikorsky ▸ CH-53K King Stallion

The CH-53K King Stallion is the USMC's new-build, heavy-lift replacement for the CH-53E, which will transport marines, heavy equipment and supplies during ship-to-shore movement in support of amphibious assault and subsequent operations ashore. The CH-53K will expand the fleet's ability to move more material more rapidly throughout the area of responsibility. Using proven and matured technologies, the King Stallion is designed to lift 12,250kg at a mission radius of 200km in hot-and-high environments – three times the baseline CH-53E lift capability. According to the company, the aircraft is designed with increased operational capabilities, improved aircraft and crew/passenger survivability, increased reliability and significantly reduced operating and maintenance costs, while maintaining virtually the same footprint as the CH-53E. The aircraft has new, more powerful engines, fly-by-wire active controls, improved main rotor blades, composite structures, an improved cargo hook handling system, elastomeric rotor blades, a glass cockpit and MFDs that integrate mission and health systems, the company states. The CH-53K programme will expand capabilities and reduce life-cycle costs through operational and support cost reductions, mission-critical range and payload increases, commonality with other assault platforms and digital connectivity and interoperability. Sikorsky officially unveiled the first CH-53K on 5 May 2014 and the USMC announced the type would be named the King Stallion. The CH-53K Engineering Development Model 1 achieved first flight on 27 October 2015. The aircraft has performed hover, sideward, rearward and forward flight up to 120kt. A second prototype aircraft joined the flight test programme in March 2016 after its first flight in January 2016. In September 2016, the company received a $232 million contract for two additional aircraft for flight qualification. In October 2016, the CH-53K successfully completed initial operational testing by the marine corps, with a low-rate initial production Milestone C decision being made in early April 2017. In May 2016, Germany issued a letter of request to the US government for pricing and availability for the possible purchase of 41 CH-53Ks. The CH-53K entered production in 2017 after the aircraft accumulated more than 450 test flight hours. Initial operating capability is scheduled to take place by the end of 2019, with a procurement objective of 200 helicopters. **Applications:** heavy lift **Rotor diameter:** 24.08m **Empty weight:** 19,845kg **MTOW:** 39,916kg **Powerplant:** 3x T408-GE-400 (7,500shp class) **Weapons:** GAU-21 .50cal door and ramp guns

Sikorsky ▸ H-92/CH-148

The H-92 is the military version of the commercial S-92 with a stand-up cabin and developed S-70 Hawk family dynamics, higher gross weights, more power and new composite rotor blades. Newly available options include dual fast rope, NVG-compatible cockpit, internal and external lighting, load-sensing cargo hook, helmet-mounted display, sliding left hatch. It is available in 22-troop utility and other mission-specific configurations, with cabin-width rear ramp. Selected as the airframe for Canada's ship-based Maritime Helicopter Programme as the CH-148 Cyclone, with a General Dynamics Mission Systems - Canada Integrated Mission System and Sonobuoy Acoustic Processing System, a Telephonics APS-143B radar and an L3 HELRAS sonar. The Royal Canadian Air Force officially accepted six CH-148 Cyclones on 19 June 2015. The final-configuration CH-148 Cyclone will be capable of ASW and ASuW as well as utility and SAR missions. In May 2014, the USN awarded Sikorsky a $1.24 billion EMD contract to modify, test and deliver six S-92s and two trainer simulators to the USMC for the VH-92A Presidential Helicopter Replacement Program. This is expected to lead to production contracts for 21 operational aircraft by 2023. **Applications:** utility, maritime, CSAR, CASEVAC **Overall length:** 20.88m including rotors **Fuselage length:** 17.1m **Rotor diameter:** 17.17m **Cabin length:** 6.1m **Cabin height:** 1.83m **Cabin width:** 2m **Empty weight:** 7,065kg **Max load on sling:** 4,530kg **Cruise speed:** (at sea level, ISA, 12,020kg) 152kt max, 138kt economic **Range:** 880km **MTOW:** 12,020kg internal load, 12,840kg external load **Powerplant:** 2x 2,500shp (take-off power) GE CT7-8 turboshafts **Seating:** 22-troop utility and other mission-specific configurations **HOGE:** 6,500ft **HIGE:** 9,000ft

Sikorsky ▸ MH-53E Sea Dragon

Sikorsky developed the MH-53E (S-80) Sea Dragon variant of its CH-53E to provide the USN with a dedicated airborne mine countermeasures (AMCM) helicopter. Equipped with enlarged fuel sponsons, the MH-53E provides long-range fleet support, detecting every known type of mine, it is claimed. The Sea Dragon incorporates GPS, Doppler radar and an approach/hover/tow coupler. The helicopter is equipped with the latest mine-sweeping systems, using mechanical, magnetic and acoustic sweep gear and mine-hunting sonar to clear vital shipping lanes. Communications include UHF/VHF/HF radios, secure communications capability and IFF. The USN also uses the MH-53E for the vertical onboard delivery (VOD) of heavy equipment to and from ships. Sikorsky built 50 aircraft for the USN, of which 28 remain in service, and the navy plans to continue using the MH-53E until at least 2025. The OEM has supplied 11 S-80 helicopters, an export variant of the MH-53E, to the Japan Maritime Self-Defense Force. **Applications:** AMCM, VOD **Overall length:** 30.2m **Fuselage length:** 22.4m **Height:** 8.6m **Range:** 1,424km **Powerplant:** 3x 4,750shp GE T64-GE-419 turboshafts **Seating:** 2 pilots, 1-6 aircrew

Sikorsky ▸ MH-60R/MH-60S Seahawk

The MH-60R 'Romeo' Seahawk, the MH-60S 'Sierra' Seahawk and the S-70B Seahawk maritime helicopters are all variants of the H-60 Black Hawk, and derived from the original SH-60B 'Bravo' Seahawk, which was retired in 2015 by the USN. The first prototype of the MH-60R made its first flight in 1999, and the following year the first prototype MH-60S made its initial flight. A new glass cockpit is common to both models. The navy received its 200th MH-60R on 13 November 2014. The MH-60R/S helicopters comprise the primary capability to detect and engage armed fast boats in defence of the carrier strike group/expeditionary strike group. The MH-60R Seahawk's primary missions are ASW and AsuW. Secondary missions also include SAR, vertical replenishment, naval surface fire support, logistics support, communications relay, personnel transport and medevac. MH-60S Seahawk missions are ASuW, combat support, humanitarian aid/disaster relief, CSAR, medevac and organic airborne mine countermeasures. In June 2011, the Australian DoD announced the acquisition of 24 MH-60Rs through the US FMS programme to meet its Air 9000 Phase 8 requirement for multirole naval combat helicopters. The first two helicopters were handed over to the Royal Australian Navy in December 2013 and the last was delivered on 1 August 2016. In November 2012, Denmark announced the purchase of nine MH-60Rs for its Maritime Helicopter Replacement programme, with all aircraft scheduled for delivery by 2018. Danish MH-60Rs will not be equipped with sonobuoy launchers and ALFS FLASH dipping sonar in order to provide internal space for transport missions. In August 2011, the Royal Thai Navy became the first export customer for the MH-60S, with the delivery of two helicopters. Specifications for MH-60R. **Applications:** vertical replenishment, amphibious and carrier

SAR, remote site logistics, airborne mine countermeasures, CSAR, special warfare support **Overall length:** 19.76m **Rotor diameter:** 16.35m **Height:** 5.1m **Empty weight:** 6,190kg **Range:** 684km; 2.7h endurance (ASW), 3.3h (ASuW) **Powerplant:** 2x 1,713shp (take-off power) GE T700-GE-401C turboshafts **MTOW:** 10,680kg **Max speed/VNE:** 135kt **Weapons:** 4x Hellfire anti-ship missiles; 2x Mk 46 or Mk 50/54 torpedoes; machine gun

Sikorsky ▸ S-61T

Developed as an anti-submarine platform for the USN, the prototype of the S-61 first flew in March 1959. The Sea King was also built under licence in Italy, Japan and the UK. Although phased out of USN service, more than 550 military H-3 Sea King and commercial S-61 helicopters continue to operate in more than 20 countries. In February 2010, Sikorsky announced that the US State Department had awarded the company a five-year indefinite delivery/indefinite quantity contract for up to 110 upgraded S-61s for passenger and cargo transport missions. In late 2013, the first upgraded S-61T made its initial flight. The S-61T includes a full structural refurbishment, overhaul of all major dynamic components, and installation of upgrades including new composite main rotor blades, a survivability suite and glass cockpit, as well as all-new electrical wiring throughout the aircraft. Sikorsky has an order to deliver 13 S-61Ts from Q1 2014. The IDIQ agreement serves as the contracting vehicle for any US government agency to purchase the S-61T. **Applications:** passenger and cargo transport **Overall length:** 22.2m **Fuselage length:** 16.8m **Rotor diameter:** 18.9m **Cabin length:** 7.59m **Cabin height:** 1.9m **Cabin width:** 1.98m **Empty weight:** 5,175kg **Payload:** 4,122kg internal, 2,721kg on sling **Cruise speed:** 120kt **MTOW:** 9,297kg **Powerplant:** 2x 1,500shp GE T58-GE-402 turboshafts **Seating:** 19 **Max range:** 1,230km with no reserve **HOGE:** 5,750ft **HIGE:** 8,550ft

Sikorsky ▸ S-70A/UH-60A/L/M Black Hawk

The Sikorsky UH-60/S-70 medium transport/utility helicopter entered US Army service in 1979 as the UH-60A Black Hawk. Since 2006, Sikorsky has been delivering the latest UH-60M variant to the US Army and various foreign militaries. The Black Hawk platform is one of the most widely deployed helicopters in military service with other variants used by the USN, USAF, USCG and numerous export customers. A widely exported assault and utility helicopter, the US Army UH-60 series aircraft have amassed over 1 million combat flight hours. The US Army UH-60A was first fielded in 1979 with T700-GE-700 engines. It was succeeded in 1987 by the UH-60L with -701C engines. UH-60M fielding to US and international customers began in 2007. The UH-60M is designed to offer reduced pilot workload, increased lift, better protection and enhanced survivability for aircraft and crew. Other variants include the USAF MH/HH-60G for special operations and SAR; UH-60Q US Army medevac aircraft; VH-60N VIP/presidential aircraft used by USMC's Marine Helicopter Squadron One; AH-60DAP, MH-60K and MH-60L US Army special operations aircraft; and the S-70A export version. In May 2001, the US Army began developing the UH-60M. This has active vibration control, open-architecture digital avionics and flight controls, composite wide-chord main rotor blades, T700-GE-701D engines, and an integrated vehicle health management system. The UH-60M flew for the first time on 23 September 2003. The HH-60M is configured for CASEVAC. The service plans to acquire 1,375 UH-60Ms with more than 800 delivered to date. Northrop Grumman is upgrading UH-60L cockpits to the digital UH-60V configuration under a contract announced in August 2014. On 30 June 2017, the US DoD awarded Sikorsky a five-year (Multi-Year IX) $3.8 billion contract for 257 Black Hawks for the US Army and FMS customers with an option for an additional

103 aircraft which could take the total contract value up to $5.2 billion. In September 2017, the US delivered the first two of 159 ex-US Army UH-60As which are being refurbished and transferred to the Afghan Air Force. In January 2018, Sikorsky was awarded a $193,850,000 firm-fixed-price foreign military sales contract for eight Saudi Arabian National Guard and nine Royal Saudi Land Forces Airborne Special Security Forces unique UH-60M aircraft. The estimated completion date is 31 December 2022. Specifications for UH-60M. **Applications:** assault, utility, CASEVAC, SAR **Overall length:** 15.4m **Rotor diameter:** 16.3m **Height:** 5.1m **Empty weight:** 5,675kg **Max load on sling:** 4,080kg **Cruise speed:** 151kt **Range:** 510km **Powerplant:** 2x 1,994shp (MCP) GE T700-701D turboshafts **MTOW:** 9,980kg gross with internal and 10,600kg with external load **Weapons:** Hellfire missiles, 70mm rockets, 30mm guns and mines

Sikorsky ▸ S-70B/SH-60B Seahawk

The SH-60B is the USN's ASW/ASuW helicopter usually embarked on frigates, destroyers and cruisers. The SH-60B entered service in 1984. It is equipped with radar and ESM and carries sonobuoys, missiles and torpedoes. SH-60F carrier-based submarine hunters are equipped with deep-dipping sonar. S-70Bs are in service with Australia, Greece, Singapore, Spain, Taiwan, Thailand and Turkey. The SH-60J is built in Japan. The S-70B aircraft is part of Sikorsky's Seahawk helicopter family that has accumulated almost four million flight hours from more than 800 operational aircraft. In December 2014, the S-70B was selected by the Indian Navy to fulfil its Multi-Role Helicopter Requirement. **Applications:** ASW, ASuW **Overall length:** 19.75m **Rotor diameter:** 16.35m **Height:** 5.2m **Empty weight:** 6,895kg **Cruise speed:** 146kt **Range:** 684km **Powerplant:** 2x 1,713shp (take-off power) GE T700-GE-401C turboshafts **MTOW:** 9,925kg **Seating:** 3-4 **Weapons:** 4x Hellfire anti-ship missiles; 2x Mk 46 or Mk 50/54 torpedoes; machine gun

Sikorsky ▸ S-70i Black Hawk

The Sikorsky UH-60/S-70 is a medium transport/utility helicopter which entered US Army service in 1979 as the UH-60A Black Hawk. Since 2006, Sikorsky has been delivering the UH-60M variant (see separate entry) to the US Army and various foreign militaries. The S-70i is an international variant that is assembled at the PZL Mielec facility, located in Poland. PZL Mielec has been a part of Sikorsky since it was acquired in 2007. The aircraft's T700-GE701D engines, digital avionics and modern wide-chord rotor blades produce the same power and lift performance as the UH-60M. Saudi Arabia's Ministry of Interior became the launch customer for the S-70i with the signing of a contract for three aircraft in 2010, and in August 2011 the company announced first delivery. In February 2014, Turkey's Defence Industry Undersecretariat (SSM) selected the S-70 for the $3.5 billion Turkish Utility Helicopter Program (TUHP). On 7 June 2016, the SSM said that following the issue of export licences from the US government, it had signed an agreement with TAI, as prime contractor, Sikorsky Aircraft, as major subcontractor, and Turkish aerospace contractors Aselsan, Turkish Engine Industries (TEI) and Alp Aviation for the TUHP. TAI will be responsible for manufacturing, final assembly operations, tests and integrated logistics support of all airframe structures and composite rotor blades. TEI will build engines under a licence from General Electric; Aselsan will develop and integrate basic avionics and will co-develop with Sikorsky an enhanced digital cockpit known as the Integrated Modular Avionics System; and Alp Aviation will carry out production and assembly of landing gears, gearbox and dynamic components. The contract covers the production of 109 helicopters over ten years for six military and government agencies. On 10 October 2016, Polish Defence Minister Antoni Macierewicz said the

government would quickly finalise a deal for S-70is for use by Polish special forces. The order is expected to be for 10-12 examples. **Applications:** utility, EMS, armed assault, fire-fighting, law enforcement, SAR **Overall length:** 19.8m (inc rotors) **Fuselage length:** 15.4m **Rotor diameter:** 16.4m **Cabin length:** 3.8m **Cabin height:** 1.4m **Cabin width:** 2.1m **Empty weight:** 5,347kg **Payload:** 4,159kg internal load, 4,650kg external load **Cruise speed:** 149kt (max), 131kt (economic) **Range:** 524km **MTOW:** 10,659kg **Powerplant:** 2x 1,939hp GE T701D turboshafts **Seating:** 14 **HOGE:** 4,300ft **HIGE:** 9,000ft

Sikorsky ▸ S-97 Raider

Sikorsky announced on 20 October 2010 its intention to design, build and test two prototype S-97 Raider light tactical helicopters 'to enable the US military to evaluate the viability of a fast and manoeuvrable next-generation rotorcraft for a variety of combat missions' within 50 months. The S-97 is based on the five-year, company-funded X2 Technology demonstration project. Like the X2 demonstrator, the S-97 Raider will feature twin coaxial counter-rotating main rotors and a pusher propeller that enables it to cruise at 220kt. Other technologies used include fly-by-wire flight controls, hub drag reduction, active vibration control and an integrated auxiliary propulsion system. Before transitioning to the S-97 project, the X2 demonstrator made 23 test flights during which it flew approximately 22 hours and on 15 September 2010 achieved a maximum cruise speed of 253kt, an unofficial speed record for a conventional helicopter. The two S-97 prototypes will be configured as assault/attack aircraft with two crew in a side-by-side cockpit and six passengers, and the ability to carry armament. Sikorsky was planning to offer the S-97 for the now cancelled US Army Armed Aerial Scout project. US Special Operations Command is considered a potential customer. On 22 May 2015, the S-97 Raider completed its first flight. During the hour-long test, the aircraft was put through manoeuvres to test its hover and low-speed capabilities. Further to this, the helicopter will undergo flight tests to demonstrate future combat operations, such as armed reconnaissance, special operations, light attack and light assaults. In 2017, the S-97 Raider reached 150kt during a flight test. **Applications:** assault, attack, scout **Overall length:** 9.6m **Rotor diameter:** 10m **Empty weight:** 3,040kg **Cruise speed:** 200kt; turn rate 2.9g **Range:** 3.5h endurance on internal fuel at a mission weight of about 4,310kg

MTOW: 4,760kg **Powerplant:** 2x GE YT706 turboshaft engines **Seating:** 2 crew in a side-by-side cockpit and 6 passengers **Weapons:** various guns, missiles and rockets planned

Sikorsky/Boeing ▸ SB>1 Defiant

Sikorsky and Boeing announced in February 2013 that they would submit a joint proposal to build a demonstrator aircraft based on Sikorsky's X2 Technology rotorcraft design for the US Army's Joint Multi Role Technology Demonstrator (JMR TD) programme which is intended to deliver the Future Vertical Lift aircraft to replace the UH-60 Black Hawk utility and AH-64 Apache attack helicopters. In August 2014, it was announced that the SB>1 Defiant is one of two designs selected to proceed to the JMR TD Phase 1. The Sikorsky-Boeing proposal intends to demonstrate how X2 technology with counter-rotating coaxial main rotors and a pusher propeller, and advanced fly-by-wire system, will deliver an efficient 230kt cruise airspeed and improve hover efficiency. The company says it is able to offer the army reduced risk, a 100kt improvement in speed, a 60% improvement in combat radius and 50% better high-hot hover performance. Sikorsky will take the lead role for the TD Phase 1, and Boeing will take the lead role for Phase 2, the mission systems demonstrator programme. In December 2016, subcontractor Swift Engineering shipped the fuselage of the first demonstrator from its facility in San Clemente, California, to Boeing's plant in Mesa, Arizona for final assembly. First flight, initially expected before the end of 2017, is now due to be 'later than' summer 2018.

TAI - Turkish Aerospace Industries ▸ T129 ATAK

The T129 ATAK is a tandem two-seat, twin-engine helicopter designed for attack and reconnaissance purposes. The T129, developed from the Leonardo A129CBT, incorporates a new system philosophy with new engines, avionics, electro-optics, weapons, a modified airframe, uprated drive train and new tail rotor, states the company. The T129 ATAK was selected in 2007 for the Turkish Land Forces and in April 2014, the ATAK Team, a partnership between TAI and Leonardo, delivered the first nine of 59 helicopters on order. On 21 September 2017, TAI announced that the 24th T129 had been delivered. A further 14 will be produced in the Phase 1 configuration. The final 21 will be delivered in the Phase 2 configuration which will include a laser warning receiver, RF mixer and radar warning receiver. The T129 cockpit provides situational awareness through good visibility arcs and integrated mission and communication systems with an avionics architecture incorporating dual aircraft central control computers and MFD pages for both crew members. With identical capability for both pilots, the targeting system enables crews to use all weapons effectively according to mission requirements. The T129 has a MIL-STD-1290 crash-worthy design, and incorporates multi-weapon asymmetric loading capability. It is equipped with a nose-mounted 20mm turret gun with 500 rounds of ammunition, and can carry up to four rocket launchers under external pylons with a total of 76 unguided rockets. It can be armed with Mizrak ATGMs, Cirit 70mm laser-guided rockets, and Stinger air-to-air missiles. A FLIR system increases image quality and range performance with real-time image processing and multiple target tracking with a thermal camera, laser rangefinder, designator and spot tracker. The relatively small radar cross-section and counter-measure systems help provide battlefield survivability, low visual, aural, radar and IR signatures. TAI is actively marketing the T129 to Pakistan where a helicopter was sent in June 2016 for evaluation. **Applications**: attack, armed escort, reconnaissance, security, urban warfare **Overall length:** 14.54m (rotor turning) **Rotor diameter:** 11.9m **Height:** 3.4m **Cruise speed:** 145kt **Range:** 537km, 3h endurance (standard tanks) **Powerplant:** 2x 1,373shp LHTEC CTS800-4A turboshafts **MTOW:** 5,065kg gross **Service ceiling:** 15,000ft **Seating:** 2 crew in tandem **HIGE:** 15,000ft **Weapons:** 20mm M197 turreted gun (500 rounds); 8x Mizrak, Hellfire or Spike ATGMs; 76x 70mm unguided rockets; 16x 70mm Cirit guided rockets; 8x Stinger AAMs **Rate of climb:** 1,430ft/min **HOGE:** 13,850ft **Max speed/ VNE:** 152kt

EQUIPMENT

ENGINES

The following section provides data on a selection of powerplants produced for rotary-wing aircraft. Entries are shown in alphabetical order by manufacturer and engine model.

The specifications listed here are intended to provide a handy, at-a-glance reference of the engines produced by each manufacturer and the aircraft they are used on. It is by no means exhaustive given the large number of re-engining programmes currently under way by third-party companies. Manufacturers and agents can supply more information on request.

If your company produces an engine that you believe should be listed in this section, please contact Karima Thibou at karima.t@shephardmedia.com to ensure it appears in the Shephard Plus online database (shephardplus.com) and is included in the next print edition.

ABOVE: In March 2018, Qatar announced it had selected Safran Helicopter Engines as the engine supplier for its new NH90 fleet. (Photo: Safran Helicopter Engines)

ATEC – ADVANCED TURBINE ENGINE COMPANY

HPW3000

The Improved Turbine Engine Program (ITEP) is the US Army's effort to build a 50% more powerful and 25% more fuel-efficient military engine for its Black Hawk and Apache fleets, as well as the next-generation Future Vertical Lift (FVL) helicopter. The HPW3000 dual-spool engine offers 20% longer engine life with a 20-35% lower production and maintenance cost, a 'drop-in' engine that requires little modification and the ability to meet the demands of the next-generation FVL platform. Engine performance: 6,000ft at 35.5°C Platforms: UH-60 Black Hawk and AH-64 Apache

GE AVIATION

GE38-1B

Three 7,500shp-class GE38-1B engines (designated T408-GE-400 by the USN) provide the power for the CH-53K King Stallion aircraft, which is scheduled for initial operational capability in 2019. The T408 gives the CH-53K helicopter the power to carry a 12,000kg external load over a mission radius of 200km in hot weather conditions, nearly triple the capacity of current aircraft. Sikorsky selected the GE38-1B turboshaft engine in 2006 for the USMC CH-53K heavy-lift helicopter programme. It provides 57% more power and 18% lower SFC than the GE T64 and has 63% fewer parts for lower operating and support costs. GE delivered the first engine for the CH-53K Ground Test Vehicle (GTV) in mid-2011. In January 2014, GE fired up the engines on the CH-53K GTV. The engine has amassed more than 3,500 test hours and 13 engines have been delivered to Sikorsky. The engine has since successfully powered the first flight of the USMC's CH-53K. Length: 1.46m Width: 68.58cm Features: architecture incorporates new aerodynamic features for more efficient operation and improved cooling schemes and materials for added durability Application: CH-53K Output: 7,500shp

T58

The General Electric T58 is a US turboshaft helicopter engine. Development commenced with a 1953 USN requirement for a helicopter turboshaft to weigh under 180kg while delivering 800hp. The engine General Electric eventually built weighed only 110kg and delivered 1,050hp. First flight was on a modified Sikorsky HSS-1 in 1957, and civil certification for the CT58-100 variant was obtained two years later. In production from 1955 to 1984, some 6,300 units were built. In July 1959, it became the first turbine engine to gain FAA certification for civil helicopter use. The engine was licence-built and further developed by de Havilland in the UK as the Gnome, in West Germany and also manufactured by Alfa Romeo and the IHI Corporation. A number of unprecedented features were incorporated into the T58, namely an all-axial compressor making the blades at the rear very small and thin; compressor handling at part speed is facilitated by several rows of variable stators at the front part of the unit; a single stage power turbine that delivers power to the rear of engine; and the combustor is a straight-through annular design, rather than reverse flow. The main production version of the engine was the T58-GE-10, developing 1,400hp, whereas the most powerful version, the T58-GE-16, produces 1,870hp. Length: 1,397mm Weight: 129kg (without reduction gearbox) Output: 1,250hp

T64

The T64 is a turboshaft/turboprop engine that now has over 11 million flight hours of operation. The T64 engine was designed to power rotary- and fixed-wing applications ranging from Sikorsky's H-53E models for marine corps and navy heavy-lift helicopters, to short take-off and landing fixed-wing transports and a multi-engine amphibious aircraft. The T64 models vary in operating temperature, diameter, length, weight and power. Country: US Width: 50.8cm/51.08cm (model dependent) Platforms: rotary- and fixed-wing

T700-701D

Designed to be rugged, reliable and maintainable, the T700-701D turboshaft engine powers the Sikorsky UH-60M Black Hawk and Boeing AH-64E. It provides improved durability and performance while still being maintainable with current GSE. In 2015, GE was awarded a $2 billion contract to support the T700 701D/401C sale to foreign militaries. GE Aviation has since supplied its T700 military-designated turboshaft engine to Firehawk Helicopters, following an exemption from the FAA to sell the engine to commercial customers. Firehawk Helicopters has subsequently deployed two UH-60A helicopters powered by T700-701D engines in support of forest fire-fighting operations in the US. The FAA exemption also clears GE to sell T700 parts to support the growing commercial fleet of UH-60A helicopters that are being divested by the US Army. T700 engines serve all five branches of the US military and numerous export customers. GE Aviation has emphasised the T700-701D's hot-and-high performance making it suitable for Firehawk's fire-fighting operations, when the aircraft lifts 2,700-3,200kg of water six to eight times per hour. A variant of the engine, the YT706, is installed on the Sikorsky S-97 coaxial compound rotorcraft. Length: 117cm Weight: 207kg Thrust range: 1,700-2,000shp Platforms: UH-60M, AH-64E

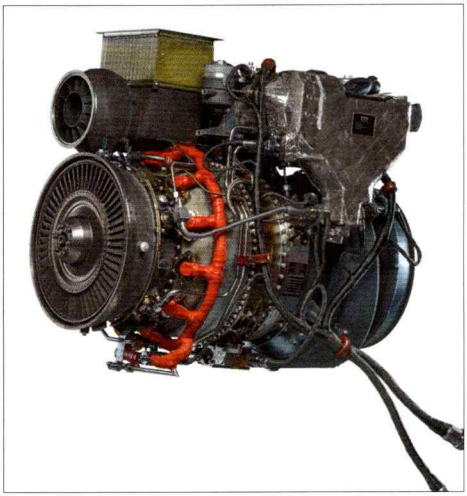
T700/CT7

Developed in response to the US Army's requirement to deliver added power and improved field maintainability, 20,000 T700/CT7 engines have now surpassed 100 million flight hours in nearly four decades of service. In addition to proving their mettle in harsh military operating environments, T700/CT7 engines have been selected by 130 customers in 50 countries supporting their transport, medical evacuation, air rescue, special operations and marine patrol needs. The T700/CT7 baseline engine was designed for the US Army's UH-60A Black Hawk as a result of lessons learned from operations in Vietnam. The US Army chose two later versions, the -701 and -701C, for the AH-64 Apache and UH-60L Black Hawk. The T700-T6E1 was the first engine used for NH90 shipboard trials. The T700-701K is now being developed, offering the first rear-drive variant of the T700 family for the Korean Surion Helicopter programme. Platforms: AH-64, UH-60L, SH-60, UH-60J, NH90, Bell 214ST, MH-60G, MH-60K, MH-60R/S, UH-60M, S-92, AH-1W, SH-2G, UH-1Y, AW101, S-97

HONEYWELL INTERNATIONAL

HTS900

The HTS900 two-spool turboshaft is the latest engine to join the Honeywell family of helicopter engines and incorporates next-generation dual-centrifugal compressor architecture. It was originally developed and FAA-certified at 1,021shp Sea Level Standard Day, in support of the



The CTS800 offers a high power-to-weight ratio and low SFC, and powers the T129 ATAK attack helicopter, among other platforms. (Image: Honeywell)

Bell 417 and ARH programmes. The HTS900 has been installed in the Bell Block II Kiowa Warrior development helicopter for demonstration purposes and the Eagle Copters 407HP helicopter on a supplemental type certificate basis. Its design comprises three modules: the accessory/reduction gearbox; the gas generator; and the combustor/power turbine assembly. A single-stage power turbine drives the front-mounted reduction gearbox and the forward and aft power output shafts. Air is directed through a reverse-flow, effusion-cooled, annular combustor. The gas generator shaft is supported by a forward thrust bearing and an aft roller bearing. The power turbine is mounted on an aft thrust bearing and two roller bearings at the front of the shaft. Main power drive is from the forward side of the accessory/reduction gearbox, with an additional co-axial tail-rotor drive on the aft side. The output gear drives through an integral, one-way, sprag-type overrunning clutch to the output shaft. Length: 935mm Height: 630mm Features: FADEC and several next-generation technologies such as single-crystal cooled gas producer turbine blades and incorporates the overriding clutch within the engine reduction gearbox Platforms: Eagle Copter STC for Bell 407, Kopter SKYe SH09, Kiowa Warrior upgrade, OH-58 Block II upgrade Output: 1,021shp

T53

The T53 is a turboshaft engine, designed for use on helicopters and fixed-wing aircraft. More than 19,000 T53-series engines have been produced to date, powering an extensive list of military and commercial helicopters. After 60 years of service, the engine has achieved more than 62 million flight hours. On the latest T53-17BCV, TBO and the demonstrated mean time before unscheduled engine removals have been increased. Length: 121cm (T53-L-703) Width: 61cm (T53-L-703) Height: 61cm (T53-L-703) Application platforms: Bell UH-1H, Huey II, Kaman K-Max, Fuji-Bell 205B Time between overhaul: 5,000h; demonstrated mean time before unscheduled engine removals over 4,000h (T53-17BCV) Take-off power: 1,800shp (max), 1,500shp (continuous) (T53-L-703)

T55

The T55-GA-7 14A is a turboshaft in the 13kg/s airflow size class. Honeywell has produced more than 6,000 T55-series engines for military and civil use, and the type has accumulated more than 12 million service hours. The T55-GA-714A US Army upgrade programme and the 55-L-714A new production or upgrade kits for international customers provide a 22% increase in power, 7% reduction in SFC and 25% total reduction in operation and support costs and the engine generates a maximum of 4,777shp at Sea Level Standard Day. A development programme is under way to support future growth requirements. A combination seven-stage axial/single-stage centrifugal compressor is driven by a two-stage gas generator. The engine is controlled by FADEC. The control system automatically prevents the engine from exceeding any of its safe operating limits throughout the environmental range and operating envelope. The engine model has been developed along with the CH-47 platform from 1,600 to over 4,800shp. Application: Boeing CH-47/Model 234 Output: 4,777shp at Sea Level Standard Day

LHTEC – LIGHT HELICOPTER TURBINE ENGINE COMPANY

CTS800

The CTS800, the result of the LHTEC partnership between Honeywell and Rolls-Royce, provides power across a range of military and civil aircraft including several versions of the Lynx family of helicopters, the AW159 Wildcat and the T129 ATAK attack helicopter. Additionally, the engine family has powered the Sikorsky X-2 Technology demonstrator to its world record speed and has been installed in a number of light- and medium-utility, scout and attack platforms. With a compact and lightweight design, the engine has a design life of up to 6,000h/20-year operation cycle and offers the highest power-to-weight ratio and lowest SFC in its power class, says the company. CTS800 engines for the Turkish Light Utility Helicopter programme will be supplied by LHTEC under a contract with Turkish Aerospace Industries, it was announced on 10 December 2015. The contract formalises an MoU signed between the companies at the 2015 Paris Air Show. Work will consist of a five-year development programme to integrate and certify the CTS800-4AT engine model on the Turkish Light Utility Helicopter platform. LHTEC plans to industrialise production and maintenance of the engine in Turkey. The commercial CTS800-4N variant was FAA-certified in November 2003 and has a speed-reduction gearbox. The CTS800-4K powers the boundary layer control system on the ShinMaywa US-2 amphibious SAR aircraft. The engine has a modular design, combining a twin-spool compressor, annular combustor and bladed four-stage turbine. The engine is capable of operating in austere environments due to the integrated particle separator inlet. The engine also has a dual-channel FADEC system. Length: 86cm Width: 56cm Weight: 170kg Assigned service life: up to 6,000h/20-year operation cycle Platforms: Lynx; AW159 Wildcat; T129; X-2; LUH

LYCOMING ENGINES

O-360 Series - HIO-360-D1A – fuel injected

The Lycoming O-360-series engines are four-cylinder, direct-drive, horizontally opposed, air-cooled models. Weight: 131kg less optional starter, alternator Application: S-300CB Specific fuel consumption: 44l/h at 75% power Take-off power: 190shp

O-360 Series - HIO-360-G1A – fuel injected

The Lycoming O-360-series engines are four-cylinder, direct-drive, horizontally opposed, air-cooled models. Weight: 119kg less optional starter, alternator Application: S-300CBi Specific fuel consumption: 41l/h at 75% power Take-off power: 180shp

O-360 Series - O-360-J2A – carbureted

The Lycoming O-360-series engines are four-cylinder, direct-drive, horizontally opposed, air-cooled models. Weight: 117kg less optional starter, alternator Application: R22 Beta II Specific fuel consumption: 35l/h at 75% power Take-off power: 225shp

O-360 Series – HIO-360-F1AD – fuel injected

The Lycoming O-360-series engines are four-cylinder, direct-drive, horizontally opposed, air-cooled models. Weight: 132kg less optional starter, alternator Application: Enstrom 280F, 280 FX, F28F Specific fuel consumption: 44l/h at 75% power Take-off power: 225shp

O-540 Series - IO-540-AE1A5 – fuel injected

The Lycoming O-540-series engines are six-cylinder, direct-drive, horizontally opposed, air-cooled models. Weight: 203kg less optional starter, alternator Application: R44 Raven II Specific fuel consumption: 57l/h at 75% power Take-off power: 260shp

O-540 Series – O-540-F1B5

The Lycoming O-540-series engines are six-cylinder, direct-drive, horizontally opposed, air-cooled models. Weight: 167kg less optional starter, alternator Application: R44 Raven I Specific fuel consumption: 57l/h at 75% power Take-off power: 260shp

MOTOR SICH

D-136/D-136 series 1

The D-136 and D-136 series 1 turboshaft engines are used to power the world's largest Mi-26 and Mi-26T Halo twin-engine transport helicopters. Main features of the engine include low fuel consumption, high reliability, high power, easy maintenance and high repairability, according to the company. Length: 3,715mm Width: 1,124mm Height: 1,382mm Weight: 1,077kg Take-off power: 11,400shp Assigned service life: 6,000h Application: Mi-26 and Mi-26T Specific fuel consumption: 0.194kg/hp

MTU AERO ENGINES

MTR390

Jointly developed by MTU, Safran Helicopter Engines and Rolls-Royce, the MTR390-2C powers the Tiger attack helicopter. ITP joined the programme for the development of the MTR390 Enhanced. The engine is based on a modular architecture (gearbox, gas generator, power turbine) and is the first engine with full condition-based maintenance. The two versions feature dual-channel FADEC and OEI 30-second emergency ratings. The 2C variant develops 1,285hp at take-off sea level ISA. The thermal power increase of the enhanced MTR-390-E is 14% for increased capabilities in hot-and-high conditions. It powers Airbus Helicopters' latest Tiger HAD. Length: 212cm Width: 79cm Height: 67cm Weight: 197kg dry Platforms: Tiger, Tiger HAD Take-off power: 2C variant develops 1,285hp at take-off sea level ISA

PRATT & WHITNEY CANADA

PT6B Family

The initial models in the PT6B series were derived directly from the PT6T TwinPac engine (see separate entry). The PT6B-37A has automatic fuel control and an electronic power turbine governor with a manual back-up - a feature claimed to be unique for single-engine operations. The 1,000shp-class single-engine configuration has been produced in six models. More than 469 PT6B engines power aircraft in service with 160 operators in 50 countries, having accumulated more than 1.7 million flying hours in applications such as HEMS, business and utility operations. The PT6B series models range in shaft horsepower from 900 to over 2,000. The basic engine layout is the same as the PT6T and PT6A turboprop; this involves a two-shaft configuration consisting of a multi-stage compressor driven by a single-stage compressor turbine and an independent shaft coupling the power turbine to the output shaft through the offset reduction gearbox. The PT6B engines power the AW119 Koala, produced by Leonardo since 2016. Length: 164cm Width: 49.5cm Height: 89cm Platforms: AW119Ke (PT6B-37A) Output: 1,000hp (PT6B-37A) Application platforms: single- and twin-engine helicopters

PT6C Family

P&WC describes the PT6C family as the latest technology for new-generation medium-class helicopters and tiltrotors. This 1,600-2,000shp-class engine series has been produced in four models and utilised for a diverse range of applications including oil exploration, HEMS, maritime patrol, business and utility operations. To date, it powers over 1,372 helicopters in service with 197 operators in 68 countries. The PT6C-67 remains a PT6 in its basic configuration with a two-shaft layout consisting of a multi-stage compressor driven by a single-stage compressor turbine and an independent shaft coupling the power turbine to the output shaft. It has engine control ranging from EEC to FADEC, which provides ease of pilot operation. Length: 165cm (PT6C-67A/C/E); 150cm (PT6C-67D) Platforms: AW609 (PT6C-67A); AW139 (PT6C-67C); H175 (PT6C-67E) Output: 1,942hp (PT6C-67A); 1,679hp (PT6C-67C); 1,777hp (PT6C-67E)

PT6T Family

The PT6T TwinPac engine has powered medium-class helicopters for four decades. The 1,800-2,000shp class twin-power engines have been produced in 11 models, and power aircraft in service with 360 operators in 99 countries. More than 7,000 PT6T engines have been produced since the family entered service in the 1990s, accumulating more than 44 million flying hours in applications such as oil exploration, EMS, maritime patrol and utility operations. The PT6T TwinPac engine, which has most notably been installed on the Agusta and Bell 212 and 412 helicopters, offers an output power of 1,800-

2,200shp. The PT6T basic configuration consists of two PT6A power sections coupled to a combining gearbox with a clutch system, enabling both twin- and single-engine operation. The power section configurations are the same as that of the PT6A turboprop, which is based on a two-shaft configuration. The engine's single-stage compressor turbine provides cooled vanes to maintain durability, and some models have electronic engine control. Length: 167cm Width: 110cm Height: 82.6cm Application: medium helicopters Platforms: Bell 212 (PT6T-3B TwinPac); Bell 412EP (PT6T-3D TwinPac); Bell 412 (PT6T-9 TwinPac) Output: 1,798hp (PT6T-3B TwinPac); 1,919hp (PT6T-3D TwinPac); 2,243hp (PT6T-9 TwinPac)

PW200 Family

The PW200 series are 500-700shp class engines designed for light twin-engine helicopters. The series includes 12 models which have been applied to a wide range of applications. PW200 engines power aircraft in service with 670 operators in79 countries with more than 4,500 engines produced since the family entered service in the 1990s. The engines have accumulated more than 8.5 million flying hours in EMS, utility, law enforcement, business and other operations. The power of the engines ranges from 500 to over 700shp. The design has three major rotating components and a modular configuration to enable easy maintenance. A single-stage centrifugal compressor driven by a single-stage turbine with a PT6-style reverse flow combustor powers a free, single-stage power turbine. The power turbine, in turn, powers the output shaft through a front-mounted reduction gearbox. The PW200's control system has an electronic engine control with hydro-mechanical backup delivering 'pilot-friendly' operation including auto-starting. The PW200 series' design provides low fuel consumption, low environmental emissions, minimum maintenance and low maintenance costs, it is claimed. Length: 9-104cm Width: 56cm Application platforms: H135 P2i (PW206B2); AW109 Power (PW206C); AW109 Grand (PW207C); Bell 427 (PW207D); Bell 429 (PW207D1); MD 900 Explorer (PW207E); Kazan Ansat (PW207K) Output: 695hp (PW206B2); 640hp (PW206C); 735hp (PW207C); 708hp (PW 207D); 719hp (PW207D1); 709hp (PW207E); 730hp (PW207K)

PW207K

The PW207K was a turboshaft engine, designed by Pratt & Whitney. In June 2001, it was announced that Pratt & Whitney Canada had sold 20 PW207K engines to Kazan Helicopters for installation on the new Ansat light twin engine helicopters. Kazan Helicopters reportedly selected the PW207K engine, a growth derivative of the PW206C engine, for the Ansat because of its efficiency, reliability and cost-effectiveness.

PW210 Family

The PW210, P&WC's 1,000shp-class engine family, is designed for single and twin-engine helicopters with improved fuel burn, power-to-weight ratio, environmental emissions and operating economics, whilst being durable and reliable. By incorporating advances in compressor-design technology and turbine materials, the PW210 will achieve its power-to-weight ratio and fuel consumption for enhanced helicopter payload and range. Furthermore, the featured dual-channel FADEC will enable ease of pilot operation and maintenance diagnostics, it is claimed. The engine has five major rotating components and a modular design for easy maintenance, according to the company. Certification of the PW210S took place in 2011. On 29 February 2016, P&WC announced that it has extended the basic time between overhaul (TBO) for its PW210 turboshaft engines from 3,500 to 4,000h, for all PW210 engines currently in service and those to be produced in the future. Length: 109cm Width: 50cm Height: 60cm Application platforms: S-76D (PW210S); AW169 (PW210A) Output: 1,076hp (PW210S)

ROLLS-ROYCE

AE 1107C-Liberty

The AE 1107C-Liberty is a new-generation 6,000shp-class turboshaft engine developed as the T406 to power the Bell-Boeing V-22 Osprey tiltrotor in service with the USMC and USAF. The AE 1107's two-shaft axial design consists of a 14-stage compressor followed by an effusion-cooled annular combustor, a two-stage gas generator turbine and a two-stage power turbine. The engine features six rows of variable compressor vanes, dual-FADEC, a self-contained oil system that allows for vertical operation, modular construction and an 'on-condition' maintenance capability. It shares a proven common core architecture with the AE 2100 and AE 3007. The AE 1107C-Liberty has been proposed as a cost-effective upgrade for existing heavylift helicopters such as the CH-47 and CH-53. Compressor: 14HP Turbine: 2HP, 2PT The AE 1107 is currently in service with the USMC (MV-22) and USAF (CV-22). Rolls-Royce has delivered more than 700 of these turboshaft engines. Length: 78.1in Width: 34.2in (Dia) Weight: 440.4kg Platforms: V-22 Take-off power: 6,160shp

M250-C20B/J

The C20B/J is described as the 'cornerstone' of the M250 engine line by the manufacturer. It is designed to provide reliability, and has benefited from enhancements developed across the M250 family. Recent improvements include first-stage turbine nozzle material that extends the component's life and maintains engine performance, along with improved gearbox lip seals and shaft journals to reduce oil consumption. Over 12,000 units have been delivered to date. Features: low SFC, 2.7:1 power/weight ratio, M250 FIRST network ready Platforms: MD 500E (C20B), Bell 206B-3 (C20J) Take-off power: 420shp

M250-C20R

The M50-C20R engine is based on the design of the C20B/J (see separate entry). The engine has a compressor with two fewer stages than the C20B, yet delivers a higher-pressure ratio. Additional improvements include an enhanced power turbine that provides up to a 5% increase in power and a 2% reduction in SFC, decreasing overall operating costs. Features: improved hot-and-high performance, lower fuel consumption and M250 FIRST network ready Platforms: MD 520N (C20R), Ka-226 (C20R/1), SW-4 (C20R/2) Take-off power: 450shp

M250-C20W

The M250-C20W engine is based on the design of the C20B/J (see separate entry). The C20W differs from previous designs in that it is configured for exhaust-down configurations. Improvements to the C20W include first-stage turbine nozzle material, which extends component life and maintains the engine's performance. This and other improvements continue to decrease direct operating costs, while increasing the mean time between removals. All improvements can be implemented in the

field. In March 2016, Enstrom Helicopter and Rolls-Royce signed a five-year agreement to provide M250 engines for the 480B helicopter, which serves as a military trainer and is in use for various civil applications. More than 220 M250-powered 480B helicopters are in service throughout the world. Features: good power-to-weight ratio and SFC, proven modular design Platforms: Enstrom 480, Fire Scout UAV Take-off power: 420shp

M250-C30

The M250-C30 and -C30P are the exclusive powerplants for the Bell 206L-4 LongRanger and the MD Helicopters MD 530F and MD 530G. In addition, the AH-6i is powered by a Rolls-Royce 250-C30R/3M engine. An optional inlet barrier filter ensures the engine's operational availability, and improved life compressor and turbine components, bearings, seals and low smoke liners can be retrofitted in the field. To date, over 2,500 engines have been fielded, with a total of more than 14 million flight hours. Features: low direct operating cost, improved lubrication system to reduce maintenance costs, improved flow path for better hot-and-high performance Platforms: MD 530F (C30), Bell 206L-4 (C30P) Take-off power: 650shp

M250-C47B/8

The C47B/8 is a hot-and-high growth variant of the M250-C47/B engine (see separate entry) for the Bell 407 helicopter. The C47B/8 supplied from the factory incorporates the former aftermarket Value Improvement Package Kit, which includes a more efficient single-stage compressor impeller, diffuser and an enhanced first stage turbine nozzle. Like the C47B, the C47B/8 engine is FADEC-equipped and has automatic engine data recording. Features: FADEC, high power-to-weight ratio (2.99:1) and SFC Platforms: Bell 407 Take-off power: 650shp

M250-C47B/M

The C47B/M is one of the latest additions to the M250 engine line. Enhancements have led to reduced cost of operation through higher life-cycle turbines and greater TBO. Like the C40 (see separate entry), the C47 is FADEC-equipped and has automated starting, rotor speed governing and automatic engine data recording. Features: FADEC, high power-to-weight ratio (2.99:1) and good SFC Platforms: Bell 407 (C47B), MD 600N (C47M) Take-off power: 650shp

M250-C47E

The C47E is the latest growth variant of the C47B/8 engine (see separate entry). In addition to a hot-and-high Value Improvement Package (VIP) Kit, the C47E also includes dual-channel FADEC. Many customers have made formal commitments for this latest engine generation and the first application on the Northrop Grumman MQ8-C Fire Scout is FAA-certified. In March 2016, Rolls-Royce announced that it had reached an agreement with MD Helicopters to launch the new M250-C47E/3 engine for the MD 530 series and growth derivative airframes. According to the company, the C47E/3 variant demonstrates an 8% improvement in hot-and-high power, a 4% increase in rated take-off power to 675shp and a reduction in specific fuel consumption, enabling increased range and payload. Features: new dual-channel FADEC, high power-to-weight ratio (2.99:1) and SFC Platforms: Northrop Grumman MQ-8C, MD 530 Take-off power: up to 700shp

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RR300

The RR300 combines new design methodologies with the legacy of the M250 engine (see separate entry) to produce a new engine family for the small rotarcraft market. Intended as a replacement for piston engines in light helicopters and general aviation aircraft, the engine has been designed to achieve performance of 240-300shp. The engine has multi-fuel capability and turbine-engine responsiveness, smoothness and claimed high reliability. The engines have been installed on the Robinson R66, Bell 47 and 300T Eagle. Features: low-cost turbine power, compact installation and lightweight configuration with good SFC Time between overhaul: 2,000h preventative maintenance interval Take-off power: 300shp Platforms: Robinson R66, Bell 47 and 300T Eagle

SAFRAN HELICOPTER ENGINES

Ardiden 1H1/1U

There are currently two models in the Ardiden 1 family: the 1H1, which powers the twin-engine Dhruv and Light Combat Helicopter from India's Hindustan Aeronautics; and the 1U, fitted to its single-engine Light Utility Helicopter. The Ardiden has a compact architecture with a gas generator made up of two centrifugal compressor stages, coupled to a single-stage high-pressure turbine and a two-stage power turbine. The dual-channel engine electronic control unit improves safety and reduces pilot workload. The Ardiden 1H1 obtained European certification in 2009 and over 250 units have been co-produced with HAL with the designation Shakti. The Ardiden 1U underwent initial bench tests in December 2014 and the first units were delivered to HAL. The Ardiden's first flight, powering the Indian LUH, took place on 6 September 2016. EASA type certification is scheduled for 2018. Length: 1.25m Application platforms: Dhruv, LCH, LUH Time between overhaul: 3,000h Take-off power: 1,400shp

Ardiden 3C/WZ16

The Ardiden 3C is fitted in the Chinese AC352, jointly developed by AVIC with Airbus Helicopters. The engine is the result of a 50/50 partnership between Safran, CAPI and Dongan, parts of the Aero Engine Corporation of China consortium. According to the company, the 3C is characterised by low fuel consumption – at least 10% less than other engines in the same power range. The Ardiden 3C was ground-tested in France in November 2013. The engine will be certified by EASA under the designation Ardiden 3C and by the Civil Aviation Administration of China under the designation WZ16. The first flight of the Avicopter AC532, powered by the WZ16 engine, took place on 20 December 2016. Features: low specific fuel burn; new generation FADEC Application platforms: AC352/Z-15 Take-off power: 1,700-2,000shp class

Ardiden 3G

Part of the 1,700-2,000shp Ardiden 3 engine family, the Ardiden 3G has a compact and modular architecture. The gas generator module comprises two centrifugal stages attached to a reverse-flow combustion chamber, a single-stage gas generator turbine, a two-stage power turbine and dual-channel FADEC. According to the company, this design ensures cost-effectiveness, particularly in terms of maintenance and cost-of-ownership. The first flight of the Ardiden 3G engine on a Russian Helicopters Ka-62 took place on 28 April 2016. The engine obtained type certification in May 2017.

The Ardiden 3G powers the Russian Helicopters Ka-62 and made its maiden flight on 25 May 2017. (Photo: Safran Helicopter Engines)

Features: low specific fuel burn Application platforms: Ka-62 Time between overhaul: 5,000h at entry into service Take-off power: 1,700-2,000shp class

Arrano

The Arrano engine is designed to equip 4-6t helicopters. The company claims that there is a 10-15% reduction in SFC when compared with previous-generation engines. The Arrano incorporates a two-stage centrifugal compressor, the aerodynamics of which are designed to deliver performance and reliability. It also has a reverse-flow combustion chamber and a single-stage power turbine. An inlet guide vane system, made up of variable-pitch blades positioned above the compressor, improves the thermodynamic cycle of the engine in cruise flight and contributes to a reduction in fuel consumption. The engine uses components manufactured using the additive manufacturing process. First bench tests of the Arrano took place in February 2014. Its first flight, powering an Airbus Helicopters H160, took place on 27 January 2016. Features: low specific fuel burn Application platforms: H160 Take-off power: 1,300shp

Arriel 1

The Arriel is Safran Helicopter Engines' best-selling engine. Since the first two models were certified in 1977, over 30 variants have been developed and certified, and are now installed on more than 40 different types of helicopter. The design of the Arriel 1 is centred around five modules for easy maintenance, says the company. It comprises a single-stage axial compressor, a single-stage centrifugal compressor, a two-stage gas generator and a single-stage power turbine. The Arriel 1D1 delivers a take-off power of 732shp and a cruising power of 625shp. The Arriel 1E2 offers a take-off power of 738shp and a cruising power of 692shp. Its maximum power available in the One Engine Inoperative (OEI) rating is 771shp. The Arriel 1S1 is particularly suited to offshore energy transport missions. The Arriel 1S1 is capable of a take-off power of 725shp and a maximum power, using the OEI rating, of 802shp.To date, Safran has produced more than 12,000 Arriel engines and the global fleet has logged more than 45 million flight hours. Application platforms: H145/UH-72A (Arriel 1E2), AW109 K2 (Arriel 1K1), BK 117C-1/C-2 (Arriel 1E2), AS350 B2 (Arriel 1D1),

Sikorsky S-76C (Arriel 1S1) Time between overhaul: 3,600h Take-off power: 590-802shp

Arriel 2+/2D

Unveiled in 2011, the Arriel 2+ is an upgrade of the Arriel 2 and is intended for single- and twin-engine helicopters. It incorporates a new axial compressor and new manufacturing materials for turbine blades. According to Safran, the Arriel 2+ offers increased performance with lower SFC, resulting in lower operating costs. Its modular design, combined with a higher time before overhaul, allows simplified maintenance. The Arriel 2+ is controlled by a new-generation dual-channel FADEC, which reduces the pilot's workload and increases safety. The engine data recorder further shifts the emphasis from traditional to preventive maintenance, helping reduce unscheduled removals and improve helicopter availability. A more recent Arriel development, the Arriel 2D, was EASA-certified in May 2011 and entered service later the same year. This variant powers the Airbus Helicopters' single-engine H125 and H130. The Arriel 2D has a HP compressor diffuser, new materials within the HP turbine and a dual-channel FADEC linked to a revised fuel system. Application platforms: H125, H130 Time between overhaul: 4,000h at entry into service with the opportunity to extend to 6,000h by implementing on-condition monitoring programme Take-off power: 850-950shp

Arriel 2B/2C

Arriel 2B/2C engines are controlled by a single-channel FADEC with integrated manual backup. The Arriel 2B1, 2C1 and 2C2 use dual-channel FADEC associated with automatic third-channel back-up. Safran claims to be the first engine manufacturer to offer dual-channel EECUs for the civil market. The engines have optimised acceleration modes and clean burning with low NOx levels. The Arriel 2B/2C versions are claimed to have the best weight-to-power ratio in their category. The Arriel 2C2 powers the H155 twin-engine helicopter and a variant of the engine was selected to re-engine the US Coast Guards' fleet of MH-65C Dolphin helicopters for sea rescue operations. Application platforms: AS365 N3/HH-65 Dauphin (Arriel 2C/2CG), H155 (Arriel 2C1/2C2), H130 (Arriel 2B1), AS350 B3 Ecureuil (Arriel 2B/2B1) Time between overhaul: 4,000h Take-off power: 700-950shp Output: 6,000rpm

Arriel 2E

One of the newest Arriel family members, the 2E was certified in December 2012 and entered service in August 2014 with the delivery of the first Airbus Helicopters H145. The Arriel 2E offers 20% more power than the 1E2 (see separate entry) installed on the EC145. It is capable of a cruising power of 828shp and maximum power, via the OEI rating, of 1,072shp. The 2E engine has a new axial compressor, a new P compressor diffuser new HP turbine blade material and a new-generation, dual-channel FADEC linked to a modernised fuel system. It also offers a special 30min power rating for occasional use. Arriel 2E comprises five modules and is controlled by the dual-channel FADEC which is designed to provide efficient power control and fuel consumption. Application platforms: H145 Time between overhaul: 4,000h Take-off power: 828-894shp

Arriel 2N

The PW210 is a 1,100shp class engine. According to P&WC, it is designed to set new standards in fuel burn, power-to-weight ratio, environmental emissions and operating economics while maintaining durability and reliability for single and twin-engine helicopters. The engine design has five rotating components and a modular design that enables easy maintenance. A two-stage centrifugal compressor driven by a single-stage turbine with a technology reverse flow combustor power a free two-stage power turbine. The power turbine, in turn, powers the output shaft through a front-mounted reduction gearbox. The combination of the reduction and engine accessory gearbox contributes to the PW210's compact design. The engine's control system also has a FADEC, which provides ease of operation, maintenance diagnostics and other control features. Certification of the PW210S took place in 2011. Length: 110cm Width: 50cm Height: 60cm Application platforms: AS565MBe Panther Time between overhaul: 4,000h Take-off power: 720-896shp Output: 6,000rpm

Arrius 2B2/2B2Plus

The Arrius 2B2, certified in 2002, delivers 40% more power than the first version of the family. It consists of two modules: a reduction gearbox module with a power output shaft tilted at 28°; and a gas generator module comprising a gas generator and turbine with single crystal blades. The Arrius family is controlled by an Electronic Engine Control Unit which provides automatic starting, over-temperature, over-torque, surge and flame-out protection as well as engine life-management functions. Certified in October 2014, the Arrius 2B2Plus is the latest in-service development of the 2B2. It entered service in December 2014 with Italian operator Aiut Alpin Dolomites, which specialises in mountain rescue missions. By the introduction of new FADEC software, the engine delivers more power than the Arrius 2B2 in hot-and-high conditions. As a result, the Airbus Helicopters H135's payload has been increased. In 2017, Safran delivered its 1000th 2B2 engine to Airbus Helicopters. The engine is designed to power helicopters which carry out missions including SAR, emergency medical transport and police patrols. Application platforms: H135 Time between overhaul: 4,000h Take-off power: 600-800shp

Arrius 2F

The Arrius 2F was designed for the light single-engine H120 developed by Airbus Helicopters. The engine delivers a take-off power of 504shp and a cruise power of 450shp. According to the company, the 2F offers simplified maintenance procedures as a result of its two-module architecture. The two modules are a reduction gearbox module and a gas generator module. The Arrius 2F has the classic Arrius structure, which consists of a centrifugal compressor, gas generator turbine and power turbine and is controlled by a hydro-mechanical fuel control unit. The engine is suitable for a range of civil, parapublic and military missions which are performed by light helicopters. Length: 1.35m Width: 0.45m Height: 0.67m Application platforms: H120 Time between overhaul: 3,000h Take-off power: 450-500shp Output: 6,000rpm

Arrius 2G1

The Arrius 2G1 has been selected by Russian Helicopters to power the Ka-226T twin-engine light helicopter. Certified in November 2011, the Arrius 2G1 is capable of a cruise power of 610shp and maximum power via the emergency OEI rating is 792shp. This engine is equipped

with FADEC and an overspeed protection system. Application platforms: Ka-226T Time between overhaul: 3,000h Take-off power: 720shp

Arrius 2K1 / 2K2

Certified in 2000 and 2003, the Arrius 2K1 and 2K2 power the AW109 Power helicopter for use by civil and military customers in medevac, EMS, rescue, law enforcement and transport missions. Both engines are controlled by an Electronic Engine Control Unit, which provides automatic starting, engine protection, training mode and engine life management functions. The time between overhaul is 3,000h and offers 40% power increase compared to earlier Arrius engine models. The Arrius 2K1 is capable of a take-off power of 670shp and a cruise power of 580shp. Its maximum power available via the One Engine Inoperative (OEI) rating is 750shp. The Arrius 2K2 powers the twin-engine AW109 Light Utility Helicopter ordered by armed forces in South Africa, Malaysia and Sweden. The LUH is used in medevac, surveillance, rescue and troop-carrier missions. Capable of a take-off power of 716shp and a cruise power of 609shp, its maximum power available via the emergency OEI rating is 791shp. Length: 973mm Width: 538mm Height: 638mm Take-off power: 670shp (2K1); 716shp (2K2) Time between overhaul: 3,000h

Arrius 2R

The Arrius 2R is the latest development in the Arrius 2 family. Launched at the 2013 Paris Air Show alongside the Bell 505, the Arrius 2R has followed a fast development schedule. An evaluation campaign started in April 2014 with its first ground run. The flight test campaign started in November 2014 with the Bell 505's first flight at the company's Mirabel facility in Canada. In August 2015, Safran Helicopter Engines delivered the first production engine to the Bell 505 assembly centre in Lafayette, Louisiana. The Arrius 2R is designed to deliver performance and power within the 500shp range, while improving safety and lowering pilot workload via the dual-channel FADEC, according to the company. Built around a proven core, the twin-module configuration offers low maintenance and operating costs. The Arrius 2R was EASA-certified in December 2015. Arrius variants have cumulatively logged 7 million flight hours. Application platforms: Bell 505 Time between overhaul: 3,000h Take-off power: 505shp

Makila 1A1/1A2/1K2

Intended for heavyweight helicopters, the Makila engine spans a power range of between 1,800-2,100shp. Production of a more powerful 1,820shp version, the Makila 1A1, began in 1984. Intended for the Super Puma Mk 2, the Makila 1A2 went into production in 1991. It was the first turboshaft engine to be certified with single-crystal vanes and to have an emergency 30s power rating. The Makila 1A1 and 1A2 engines are intended for the twin-engine SA330 Puma, AS332 and AS562 Super Puma helicopters. The Makila 1A1 powers the latest version of the Super Puma: the H215. The Makila 1K2 is installed in South Africa's Denel Aviation Rooivalk attack helicopter. The Makila 1A1 delivers a take-off power of 1,820shp and a cruising power of 1,589shp. Maximum power using the One Engine Inoperative (OEI) rating is 1,877shp. The 1A2 delivers a take-off power of 1,845shp and a cruising power of 1,657shp. Maximum power using the One Engine Inoperative (OEI) rating is 2,109shp. In common with the other members of the Makila 1 family, the 1A1 and 1A2 are designed around a five-module architecture: an air intake, a three-stage axial compressor, a gas generator (including a centrifugal compressor stage, an annular combustion chamber and a two-stage turbine) an intermediate diffuser and a two-stage power turbine. Latest versions also incorporate FADEC. To date, over 2,200 Makila engines are in service worldwide. This fleet has logged in excess of 10 million operating hours. Platform name: AS332, AS532, SA 330 Time between overhaul: 3,500h Take-off power: 2,100shp

Makila 2A/2A1

At the end of the 1990s, Turbomeca (now Safran) launched the 2,000shp Makila 2. This variant is effective for transport missions to offshore oil and gas production areas. The Makila 2 incorporates an axial/centrifugal compressor and a two-stage power turbine with reinforced blades. The power turbine has a 'blade-shedding' capability which, in case of internal failure, confines any damage to within the engine's shroud. Certified in 2004, the Makila 2A offers 14% more power than the 1A2 (see separate entry). Front air intake means there are no installation losses, and a FADEC-controlled bleed valve optimises fuel consumption and surge margins. There are four replaceable modules for easy maintenance; boroscope and magnetic indicator inspections can be undertaken without removing the modules. The engine is claimed to have low direct-maintenance costs, and the dual-channel FADEC with over-speed protection improves overall safety and decreases pilot workload. The Makila 2A dual-channel FADEC surpasses current JAR E amendment 11 performance. Application platforms: H225, H225M Time between overhaul: 3,500h Take-off power: 2,100shp

RTM 322

The architecture of the RTM 322 includes a four-stage compressor, three axial and one centrifugal stage, a two-stage turbine equipped with single-crystal vanes and a two-stage power turbine. The RTM 322 was designed to maximise performance in terms of acceleration, maintenance through reduced number parts and easy access to modules and robustness as the engine is capable of withstanding marine and desert environments. The engine is also equipped with a dual-channel FADEC which is designed to lighten pilot workload and enhance flight safety. In total over 1,100 RTM 322 engines are in service, between them logging in excess of 1 million flight hours. Currently the engine powers three types of aircraft: the twin-engine NH90, the AW101 and the Apache AH Mk.1. To date the engine powers 90% of the global fleet of AW101 helicopters and 80% of in-service NH90s. The RTM 322 has been certified by the European Aviation Safety Agency and meets a range of customer requirements including tactical transportation, SAR at sea and in combat zones and maritime missions. Application platforms: AW101, NH90, Apache AH1 Output: 2,100-2,600shp Application: SAR, tactical transportation and maritime missions Output: 20,900rpm

TM 333

The TM 333 is designed for helicopters weighing 4-5t, offering low fuel consumption and maintenance. It became functional in August 1981, and completed its 150h endurance run the following year. It gained civil certification and was introduced commercially in the mid-

1980s. The first Turbomeca (now Safran) engine to use a single-stage turbine that made it more compact than its predecessors, the engine's original design saw the engine rated at 750hp continuous. However, it was designed to allow for future power increases, and the later 2B2 variant enabled 1,100hp. The TM 333 2B2 variant powered early versions of the HAL Dhruv, though it was replaced by the Shakti (Ardiden) engine, which was jointly developed by HAL and Turbomeca. The TM333 2M2 variant is used on the HAL Cheetal and Chetan, the upgraded versions of the Cheetah and Chetak respectively. Weight: 140kg Output: 751shp Take-off power: 838shp Specific fuel consumption: 0.523 16hp/hour

UNITED ENGINE CORPORATION (KLIMOV)

TV2-117A

The TV2-117A turboshaft engine is a development of the TV2-117, which was designed in the early 1960s to power the Mi-8 medium helicopter. More than 23,000 TV2-117 series engines have been produced, accumulating over 100 million flight hours. Assigned service life: 12,000h Platforms: Mi-8T and other variants Output: 1,480hp Take-off power: 1,500hp

TV3-117

The TV3-117 turboshaft engine was designed in the early 1970s to power the Mi-14 and Mi-24, and more than 95% of Russian medium helicopters are powered by this design. More than 25,000 engines have been built, and have accumulated more than 16 million hours in operation. The engines, except those used on the Mi-28, include gearboxes – VR-14, VR-24, VR-25, VR-80 – designed by Klimov. The TV3-17 engines have a power output of 2,000-2,400 horsepower. Variants include the TV3-117MT (upgraded, transport), TV3-117VM (high-altitude, upgraded) and TV3-117VMA (high-altitude, upgraded, modification A). Length: 205cm Width: 66cm Height: 73cm Weight: 295kg Platforms: Mi-8MT, Mi-17, Mi-172 (TV3-117MT); Mi-8MT, Mi-17, Mi-28, Mi-171 (TV3-117VM); Ka-27, Ka-29, Ka-31, Ka-32, Ka-50, Ka-52, Mi-24, Mi-28 (TV3-117VMA) Output: 1,970hp (TV3-117MT); 2,070hp (TV3-117VM); 2,170hp (TV3-117VMA) Specific fuel consumption: 215-220g/hp/h

TV7-117V

The TV7-117V engine was developed for Mi-38 helicopters and serial production started in June 2016. The engines' power classes range from 2,500-3,000hp. Two models are available: the TV7-117V/VM with front power shaft for the Mi-38; and the TV7-117VK with rear power shaft for upgrading Mi-28 and Ka50/Ka52 helicopters. The engine has a FADEC system. More than 200 engines of the TV7-117V family are expected to be released by 2020. Length: 1,614mm Width: 640mm Height: 820mm Weight: 360kg Take-off power: 2,000hp Platforms: Mi-38 (TV7-117V/VM), Mi-28, Ka50/Ka52 (TV7-117VK)

VK-2500

The VK-2500 turboshaft was developed in 2001 as an upgraded version of the TV3-117VMA. The engine has a claimed low specific fuel consumption, low power-to-weight ratio, high reliability, long service life and high maintainability/repairability. The VK-2500 has an emergency power feature of 2,700hp. VK-2500 engines are installed on helicopters that serve mountain rescue

The 1,500hp-class RD-600V has FADEC with a reserve hydromechanical channel. It is in production in Russia. (Photo: United Engine Corporation)

units of the Russian Ministry of Emergency Situations. The Klimov company delivered 60 engines to the Russian MoD in 2016, with as many as 100 further engines planned for production in 2017.The engines have been installed on modified Mi-17 and Ka-32 helicopters, Mi-28, Ka-52 and Mi-35 platforms and is designed to offer an upgrade option for helicopters equipped with TV3-117 engines. Length: 2,055mm Width: 660mm Height: 728mm Weight: 300kg Assigned service life: 9,000h Platforms: Mi-8MT/Mi-17, Mi-171Sh, Mi-24, Mi-14, Ka32, Ka-50, Mi-28, Ka-52, Mi-35 Take-off power: 2,000hp

UNITED ENGINE CORPORATION (NPO SATURN)

RD-600V

The modular RD-600V turboshaft for medium multipurpose helicopters is the only 1,500hp-class engine in production in Russia. The engine has FADEC with a reserve hydromechanical channel, offering the possibility of certification to international standards and operation of the engine without limitations worldwide, as well as improved flight safety. It also has a developed system of control and diagnostics for ease of operation and maintenance, a dust protection device, and built-in auxiliary reduction gear to reduce turbine shaft rotations to 6,000rpm. RD-600V engines can operate with Russian and foreign fuels and oils. Length: 1.6m Width: 0.75m (dia) Application platforms: Ka-60, Ka-62 Take-off power: 1,500hp

EQUIPMENT

INTEGRATED MISSION SYSTEMS

A selection of offerings from the major companies that integrate military mission systems into rotorcraft. Helicopter manufacturers are capable of completing this kind of work, but are increasingly partnering with outside systems houses such as those listed here. The entries in this section include examples of their work, which is tailored to the requirements of individual customers.

Entries are arranged alphabetically by company name.

If your company produces equipment that you believe should be listed in this section, please contact Karima Thibou at karima.t@shephardmedia.com to ensure it appears in the Shephard Plus online database (shephardplus.com) and is included in the next print edition.

ABOVE: An aircrewman operates the sensor console in HMAS *Darwin*'s S-70B-2 Seahawk helicopter for an ASW exercise during Exercise *Kakadu*. (Photo: Royal Australian Navy)

AIRBUS DEFENCE & SPACE (GERMANY)

Sferion

As a pilot assistance system, Sferion is designed to raise situational awareness and supports decisions relevant to the flight, especially in extreme conditions with poor visibility such as darkness, fog, brownout and whiteout. Sferion offers mission and navigation support, as well as reliable obstacle detection in real time and pilot assistance during all flight phases. The possibility to record, transfer and analyse flight and mission data completes the Sferion portfolio. Components include: SferiAdvise, SferiSense, SferiAssist and SferiRec. Airbus Defence and Space demonstrated the ability of Sferion to protect helicopters in restricted visibility conditions through a series of live flights during the German Army Aviation's Helicopter Forum in August 2015. These were conducted on a Bell 206. Applications: Situational awareness, mission and navigation support, obstacle detection

ASTRONAUTICS CORPORATION OF AMERICA

Tactix

Tactix is a modular tactical mission system for airborne application, providing situational awareness and combined presentation of route, threat-avoidance-zone targets, terrain-related information and a full airborne tactical view of the combat arena, based on ship sensors and data-linked information. Tactix may reside side by side with the avionics and/or modern mission-related capabilities of an existing aircraft. Alternatively, it may be integrated with multiple onboard communication devices (satellite communication, data-link radio etc), or incorporate its own data-link radio. The system combines a digital map, mission data presentation, situational awareness overlays (threats, allied forces, flight plan etc) and onboard sensor data/video on a combined mission display for crew members. Tactix includes a ruggedised flexible video/data multiplexer, supporting flexibility/redundancy operation, and 4G data-link radio, allowing wideband, instantaneous, ad hoc networking. It is provided in several levels: the Basic system for a single user; the Duo/Treo, which supports a network of two/three crew members, operating the system simultaneously and sharing data; and the Tactix Flex, that adds onboard flexibility and redundancy, allowing each crew member to view each other's displays, or to take control of any other computer as a backup. Applications: Tactical display and control Systems integrated: Digital moving map, FLIR, CCD live video display and sensor control, radar

BIRD AEROSYSTEMS

ASIO MSIS

Bird Aerosystems' Airborne Surveillance Intelligence and Observation (ASIO) is a customisable ISR product that addresses a variety of operational requirements, ranging from military and homeland protection to environmental monitoring and surveying missions. The ASIO system provides airborne reconnaissance and surveillance, enabling early detection, identification, tracking and interception of relevant threats. It has been installed on a variety of rotary- and fixed-wing platforms, including the Beechcraft King Air 350, Cessna Citation and Bell 407. Sensors are integrated by Bird's Multi Sensor Integration System (MSIS), which provides a real-time situational awareness picture of military, paramilitary and civilian targets in the air and on the ground. Open-architecture engineering provides the flexibility to integrate any required mission sensors and systems. The system enables collection of a large amount of data that is automatically classified and clearly displayed using a human-machine interface. The system has a C2 application for management of all mission phases, real-time data collection, correlation and target analysis. Sensors and subsystems can be automatically activated, and the system features the integration and display of layered information in accordance with NATO symbolic, internal communication and integrated tasking. Information can be recorded and played back live. In July 2015, Bird Aerosystems and Bell Helicopter signed a cooperation agreement to integrate ASIO as an ISR solution for the Bell 407 GXP. The Bell 407 ASIO includes a variety of detection and surveillance airborne sensors and communication systems, all integrated with MSIS mission management system and delivered as a full turnkey product including design, integration on the helicopter, mission operations, training and support. Systems integrated: SAR/, EO/IR, COMINT, ELINT, MSIS

CONTROP PRECISION TECHNOLOGIES

FPD-1

The FPD-1 is a ruggedised, flat-panel colour TV display with high brightness, developed for rotary- and fixed-wing aircraft, but is also suitable for a range of other applications such as on ground vehicles and sea vessels. The Super VGA display comes in LCD active matrix (TFT) screen sizes and is compatible to operate at altitudes of up to 20,000ft. Length: 300mm (main housing), 130mm (control unit) Width: 230mm (main housing), 50mm (control unit) Height: 100mm (main housing), 35mm (control unit) Power: 18-32V DC Weight: 5.3kg Response time: 20m/s Display: 640x480px; 800x600px optional Data interfaces: Serial communication links MIL standard codes: MIL-STD-810 Video formats: Video input Y/C, VGA input, PAL, NTSC (with option for Y/C and VGA) Image dimensions: 211x158mm (HxW) Brightness: 1,000cd/m² Contrast ratio: 1/150 Viewing angle - vertical: +70° to -40° Viewing angle - horizontal: ±70° Display dimensions: 21cm or 43cm ruggedised flat-panel display monitors Mechanical interfaces: Rear mounting (bezel option), two optional mountings on main housing

FPD-2

Larger than the FPD-1 (see separate entry), the FPD-2 is also a ruggedised, high-brightness, flat-panel colour TV display developed for rotary- and fixed-wing aircraft, but suitable for other applications. The flat panel monitor is for use with air, land and naval platforms and applications, with the Super VGA display coming in LCD active matrix (TFT) screen sizes that are compatible to operate at altitudes of up to 20,000ft. Applications: Rotary- and fixed-wing aircraft, patrol aircraft, helicopter cockpits, patrol boats, armoured vehicles Length: 148mm (basic monitor) Width: 220mm (basic monitor) Height: 165mm (basic monitor) Power: 18-32V DC Weight: 3.7kg Response time: 50m/s Mechanical interfaces: Side flanges; optional customised mounting Display: 21cm or 43cm flat-panel LCD colour display, 800x600px Data interfaces: Optional serial communication links MIL standard codes: MIL-STD-810 Video formats: PAL, NTSC; options Y/C

input. Super VGA input, high-altitude (20,000ft); colours 262K Image dimensions: 170x128mm (HxW) Brightness: 1,400cd/m² Contrast ratio: 1/250 Viewing angle - vertical: +60/-45° Viewing angle - horizontal: ±60°

CURTISS-WRIGHT DEFENSE SOLUTIONS

Mission Displays Family

The Mission Displays Family offers a wide range of multi-function rugged LCD displays for rotary- and fixed-wing aircraft. The HD displays are designed for use with FLIR and long-range daylight video cameras, moving maps, computers and radar. All avionics displays offer multiple video inputs, VGA inputs, picture-in-picture facility, video freeze frame, digital zoom and internal NVG filters that eliminate the need for external NVG filters. Applications: LCD displays for rotary- and fixed-wing aircraft Display dimensions: 165-508mm units

MPMC-9105

The MPMC-9105 Mission Computer is one of the smallest members of Curtiss-Wright's integrated subsystems family of application-ready COTS systems, and is designed for vetronic and avionics requirements, providing a set of IO coupled to Intel dual- and quad-core processors alongside up to four SSDs. Packaged in a compact form factor, the MPMC-9105 integrated system is suitable for both low-power systems and high-performance computing. This chassis is designed to operate in conditions including extreme temperatures, shock, vibration and EMI to MIL-STD-810F. The circuit cards installed in the sealed chassis are isolated from external environmental conditions such as humidity, dust and sand. Type: mission computer Length: 23cm Width: 28cm Height: 9cm Power: 28V DC input Weight: 6kg Shock rating: MIL-STD-810F Operating temperature range: -40 to +55°C

MPMC-9335 Mission Computer

The MPMC-9335 rugged mission computer system uses packaging techniques to provide the processing power of the latest quad-core Intel-based SBC and Nvidia Fermi GPU in a rugged enclosure that measures 250in. The MPMC-9335-0001 3U OpenVPX three-slot baseplate-cooled COTS product is a flexible processing system that can be configured to meet the needs of any military or aerospace requirements, from benign laboratory to harsh deployed airborne vehicle environments. The chassis meets MIL-STD-810 and DO-160E environmental standards for a range of conditions such as temperature, altitude, shock, vibration, fluid susceptibility, voltage spikes and electrostatic discharge. In the system's sealed chassis, the MPMC-9335 circuit cards are protected from external environmental conditions such as dust, sand and humidity. For improved performance and reliability, the system is designed to resist external EMI and minimize emissions. Applications: Rugged mission computer Operating temperature: Up to 71°C using baseplate cooling MIL Standards: MIL-STD-810

Parvus DuraMAR 5915

The Parvus DuraMAR 5915 is a rugged COTS Cisco IOS-managed secure mobile network router integrating Cisco's 5915 Embedded Services Router card in a rugged chassis suitable for harsh military and civil vehicle/aircraft installations. The 0X model series (MAR-5915-0X) is a standalone variant with a total of five Ethernet ports. The DuraMAR 5915 enables the deployment of data, video and voice services from almost anywhere that LAN/WAN connectivity may be required, especially in mobile, airborne, ground, manned or unmanned vehicle and sensor applications. Applications: Civil and Military Tactical In-Vehicle LAN Switching / WAN Routing MIL Standards: MIL-STD-810G Shock, Vibration, Thermal, Altitude, circular MIL-DTL-38999 Connectors for Reliable Network Connections

Parvus DuraNET 30-2020

The Parvus DuraNET 30-2020 is a rugged 19-port Cisco IOS-managed Layer 2 network switch, integrating Cisco's ESS 2020 Embedded Services Switch technology with an isolated MIL-STD-1275/704 power supply in an IP67 (dust/waterproof) sealed aluminium chassis with MIL-DTL-38999 connectors. It is designed for SWaP-sensitive harsh military and civil environments. The unit provides LAN switching capabilities with secure access and easy manageability. There are two levels of Cisco IOS software (LAN Lite or LAN Base) that are available to support access layer connectivity and needs for data, security, voice and video traffic at the network edge for stationary or mobile network nodes. Applications: Network-Centric Operations / Situational Awareness Systems integrated: Cisco ESS 2020 Layer 2+ IOS Managed Ethernet Switch MIL Standards: MIL-STD-810G and DO-160G, MIL-STD-461F, MIL-STD-1275D, MIL-STD-704F

VMS

The Video Management System (VMS) offers surveillance solutions for rotary- and fixed-wing aircraft. VMS includes rugged displays, video distribution and recording equipment that are scalable, interoperable and easy to install and reconfigure, says the company. VMS has been fielded in a range of applications, including SAR and border patrol. The VMS integrates mission video equipment in an aircraft, allowing the operator to display a video channel at any time on any display, have control over connected video recorders including live playback and changing the channel being recorded, touchscreen control over connected moving maps or PC equipment, and the ability to change channels going to any downlink equipment. Specifications vary as it is designed to meet individual customised requirements using a range of display, video recorder and video distribution systems. Type: scalable video display, recording and distribution system

Vortex DTS

The Vortex Data Transport System (DTS) SWaP-optimised, rugged network file server is designed to support industry-standard storage protocols (NFS, CIFS, HTTP and FTP) through four 1GbE ports. To protect critical data-at-rest, the Vortex DTS network attached storage system offers an AES 256-bit encryption option or special encrypted SSDs certified in the UK. The DTS scalable storage includes three rugged removable memory cartridges for mission, map and maintenance data. With no moving parts or air-pressure dependent components, the Vortex DTS is suitable for cockpits and other size-limited, mobile environments. Applications: Data transport system

VRDV-5004

The VRDV-5004 is a compact, lightweight HD video recorder. It features a flash-based design with playback during flight. The VRDV-5004-01 offers a solid-state design, providing performance in extreme temperatures

The Parvus DuraNET 30-2020 is designed for SWaP-sensitive harsh military environments. (Image: Curtiss-Wright Defense Solutions)

and high G, and is constructed in rugged all-aluminium with DZUS fasteners. It is designed to record to affordable CompactFlash cards and provides file-based, tapeless workflow and storage. Without the need to rewind, the VRDV-5004 provides instant playback. It facilitates file transfer to Blu-Ray Disc for playback on any media PC, and it offers low bit rate and high compression, minimizing mission storage requirements. The system is fitted with CODEC for video compression. Audio capabilities of the VRDV-5004 include 24-bit/48K audio with embedded or analogue inputs and line level output. Recording is done with up to two CompactFlash cards. When one card fills, the recording seamlessly switches to the second card. Recording bit rates are set at the factory with the default setting at 35 MB/s. Recording time varies by bit rates, from 40 minutes for one 32GB card at 100MB/s to 210 minutes for one 32GB card at 19MB/s. Applications: Integrated video recorder

ELBIT SYSTEMS

Helicopter Mission Systems

Elbit Systems' helicopter modernisation activities are focused on upgrading existing utility and attack platforms, supplying systems for latest-generation aircraft, converting utility and assault helicopters into multi-role platforms, and providing full maintenance and support. The company can act as a prime contractor, systems integrator, component supplier or as sub-contractor to local industry. The use of open-architecture technology is designed to increase modularity and upgrade paths. Fused avionics minimise the number of units and, along with test equipment for all maintenance levels, reduces life-cycle costs. Mission systems are based on a set of core technologies, including a helmet display and tracking system to present flight and mission information by day and night directly in the pilot's FOV and provide slaving capabilities to sensors. The BrightNite system (see separate entry) aids missions conducted in extreme DVE conditions, and stabilised EO payloads allow for day and night observation, detection, recognition and identification of targets at all ranges. Mission systems also include MFDs, a digital map system that presents real-time maps in different scales and formats overlaid with tactical information, an EW suite comprising MWS, radar warning receiver/laser warning system, and chaff/flares to improve helicopter survivability. The cockpit integration unit is a cockpit and avionics control computer with an LCD display terminal. There is a ground-based mission planning and debriefing station; mission-related data includes navigational routes, threats, targets, communication and stores. Data link and C4I systems fuse all available battlefield information, deliver mission-critical information and presents a clear picture to pilots and all command levels. An obstacle warning system alerts crews to obstacles. Operating platforms: Over 25 types of military helicopters, including CH-53D/E, AH-1S/W, CH-46E, CH-47D, Puma 330, UH-60/HH-60, AS565, UH-1N, Mi-17 and Mi-24

Helic^{3}om

Helic^{3}om is a fully digital, integrated C3 and mission management system designed to provide crew with data communications and accurate, real-time tactical pictures. The modular system was designed to grow as needs evolve, from a single helicopter, to a formation, to an air force. Installed in a variety of platforms, Helic^{3}om was developed by active pilots whose combat experience is incorporated into all facets of the system. Designed to be intuitive to operate, it features a GUI with mission editing, touchscreen control and single-hand mouse/HOCAS operation. It is based on a digital moving map tactical situation display and an advanced data link that operates on up to four independent nets using onboard radios for data communications with voice override. It calculates mission times, fuel, distances and bearings. From the map, it calculates LOS, obstacles, LOS versus height and threats. It also calculates available performance according to altitude, temperature and available power. The C2 station is based on a rugged laptop. Helic^{3}om is part of Elbit Systems' CAESAR avionics suite for CSAR missions. Applications: C3 and mission management

LEAP

Elbit has developed the Light Enhanced Armament Package (LEAP) to convert utility helicopters into multirole platforms capable of performing a variety of missions such as attack, close-support, self-defence, troop evacuation, CSAR and reconnaissance. The ability to easily convert a helicopter from peacetime utility missions to armed missions provides a life-cycle cost saving, according to the company. The LEAP can be tailored to customer requirements, and can be equipped with accurate 70/80mm laser-guided rockets, EOP, an armament and ballistic computer, ANVIS/HUD 24T helmet-mounted system, including tracking capabilities and LoS. According to the company, the combination of elements offered in LEAP allows intuitive mission management, real-time ballistic accuracy, effective armament management and fire launch, and full display of the flight data that is superimposed onto the day or night pilot's HUD. The LEAP can be integrated into the platform with a minimal increase in weight. Applications: Conversion of utility helicopters into multirole platforms Operating platforms: Integrated on several platforms Systems integrated: Avionic upgrade, EO payload, DMAP laser-guided rockets

ELBIT SYSTEMS EW & SIGINT – ELISRA

ASARS-G

The Airborne Search and Rescue System (ASARS) consists of the ARS-700G installed in CSAR aircraft, which communicates with personal survival radios (PSRs) such as the PRC-434 family, and is also compatible with

the PRC-112 family and other NATO rescue systems, air, ground and naval. It offers range measurement, 360° DF capability and up to 200km range. Short-burst interrogations (0.6s) and selective call codes can help stop hostile detection of survivors and rescuers, enabling tracking of up to 100 survivors. It has 3,000 operating frequencies, and UHF and VHF voice comms on all frequencies. It can be installed with no aircraft mods. ASARS-G adds: survivor position location using received GPS data; navigational support to approach survivor or SOF team by safest route; encrypted data such as present position, route and waypoints; pick-up location and canned messages can be sent over any channel; embedded GPS in PSR can be activated remotely by airborne units. Airborne relay capability gives OTH range. Includes optional thermal beacon fitted to PSRs to pinpoint survivor visually from around 5km. Applications: SAR Operating temperature: -40/+55°C Power supply: Battery life: 15h at 1:10 T/R ratio, 24h at 121.5MHz

CQ1 Kneeboard/Handheld Airborne CSAR Interrogator

The CQ1 is a compact, lightweight PLS based on a ruggedised tablet PC running Windows XP Professional OS, in a configuration optimised for rugged, wearable kneeboard requirements. The CQ1 interfaces to the aircraft intercom system via the integral helmet connector, enabling the aircrew to locate survivors by means of GPS geo-location data and text messages, processed by a dedicated modem and displayed on a moving map. Multiple layers can be displayed on the map, allowing visualisation of pre-flight loaded information such as terrain features, threats etc, to assist aircrew in performing the rescue mission. Encryption capability is available on demand. For compatibility with non-combat beacon radios, a miniaturised 406MHz receiver can be connected to allow extraction of GPS geo-location data from the Cospas-Sarsat protocol. In addition to the data acquired by the CQ1, computed data including range, bearing and time of arrival to the survivor is also available. The tablet computer is powered by a VIA Eden 1GHz ULV processor. The system features the VIA

The IDU-450 is an integrated electronic flight instrument system that provides helicopter pilots with 3D synthetic vision. (Image: Genesys Aerosystems)

Graphics UniChrome Pro IGP core that supports both 2D and 3D graphics. A 16.5cm diagonal LCD monitor features LED backlight and integrated touch panel. The transflective display is daylight readable and dimmable for night vision compatibility. An internal solid-state disc drive providing 32GB of storage capacity is also available. Display dimensions: 16.5cm diagonal LCD monitor

ETEP

DTMUX DVR

The DTMUX Digital Video Recorder (DVR) is designed for airborne video surveillance including SAR or other video recording needs. It provides full HD 1080p, H.264 or MJPEG 2000 compression. The DTMUX DVR allows users to record and replay one HD channel at the same time, or record one to four HD video channels with post replay. The unit offers two ways to remove the video data, either directly with the removable memory cartridge, or by connecting a USB stick. The recorded data is directly readable on any computer. Video audio modules: video MPEG 2000/audio, video/audio H.264 MPEG4 audio Applications: Airborne video recording Width: 14.5cm Height: 8.6cm Weight: 2kg Power supply: 28V DC (18-36V)

DTMUX M

The DTMUX M is a mission airborne data recorder designed for adding digital video, audio and data recording functionality in new and legacy airborne platforms. It offers easy plug-in integration in the cockpit side panel. DTMUX M enables recording of a range of signals like video/audio channels (H.264 or JPEG 2000 Wavelet compression) in Full HD 1080p or lower (PAL/SECAM). The video and audio modules are video/audio H.264 (MPEG4) and MPEG 2000, with an HD camera and area microphone in a crash-protected memory unit. Applications: Helicopter, aircraft and combat vehicle mission downloading/debriefing, reconnaissance and surveillance, damage assessment Width: 12.7cm Height: 7.62cm Weight: 1.3kg Power supply: 28V DC (18 to 36V) MIL Standards: MIL-STD-1553, ARINC 429, AFDX ARINC 664, and RS232/422/485

DTMUX M2

The DTMUX M2 mission recorder is designed for cockpit installation with quick access to the memory cartridge for post-flight analysis. It is capable of recording HD video/audio (720p/i or 1080p/i) or lower resolution PAL/NTSC, digital data bus (MIL-STD-1553, ARINC 429) and analogue data (such as strain gauges). The system features lightweight, quick-access recorder, 8GB-256GB, full NVG/night/day compatibility, qualified MIL-SPEC for airborne use, panel mounted with DZUS fasteners and events marker. Width: 14.5cm Height: 8.32cm Weight: 1.4kg Power supply: 28V DC (18 to 36V)

DTMUX Nano

The DTMUX Nano is a small airborne data, voice and video recorder device with quick access from 4 to 256GB of solid-state disk memory. Mission purposes include surveillance and reconnaissance. It is able to record many parameters in reduced volume and record simultaneously analogue/digital, video and audio data. Modules: differential voltage; strain gauges/bridge signal Digital buses: PCM Acquisition; serial FPDP; ARINC 429; MIL-STD-1553; AFDX/ARINC 664, STANAG 3910; Ethernet; CAN bus; differential discrete;

pulses measure/counter; RS422/485, RS232 Video/audio modules: video MPEG 2000/audio, video/audio H.264 (MPEG4) audio. It also features an HD camera and area microphone, crash protected memory unit. Applications: Helicopter, aircraft, vehicle mission downloading/debriefing, reconnaissance and surveillance, damage assessment Width: 11.2cm Height: 6.85cm Weight: 1kg Power supply: 28V DC (18 to 36V)

NanoS2

The NanoS2 acquisition system combines a data concentrator and a compact flight test recorder, which provides modularity and permits stacking of 12 data acquisition modules by unit in the same device. A unit is comprised of a CPU module with a recording capacity of 8-256GB or a CPU module without storage function, and a power supply module. The CPU Module utility channels feature RS232 com, NanoS2 functioning, audio channel, time stamping, Irig B Channel, Ethernet 10/100/1000UDP, Ethernet 10/100/1000UDP, master/slave(s) link, micro D connector, analogue/sensors modules, digital bus modules, video/audio, PCM real time, network coupling, and universal recorder software. Applications: Flight test recorder Length: 110mm Width: 112mm Height: 74mm (1 user module), 272mm (12 users module) Weight: 1.2kg (2 users module), 2.8kg (12 users module) Power supply: 28Vdc for MIL-STD-704

Sentinel CSMU

The Sentinel Crash Survivable Memory Unit (CSMU) is an optional unit design for all of ETEP's airborne data recorders. It has been designed to meet all the performance and survivability requirements of EURO CAE ED-155 or ED-112 normalisation. There is the CSMU-ED155 light version, and the CSMU-ED112 rugged version. It features high-level data-encryption technology (private key) on crash-protected memory (CPM) to ensure data security in all circumstances. Its memory capacity is CPM 4, 8, 64 or 128GB. Applications: Helicopters, commercial and military fixed-wing aircraft, UAVs Width: 12.4cm Height: 10cm Weight: 3kg Power supply: 12-28V DC, MIL-STD-704E

Sentinel - ED-155

The Sentinel is an integrated flight data recorder system for ED-155 standard requirements. It has the capability for data audio recording and airborne image recording in a single lightweight recorder for turbine aircraft weighing less than 5,700kg. Its specifications are two audio channels, two video channels, optional internal sensors for three-axis gyro, three-axis G sensor, air pressure sensor, aircraft data link, the most recent 25h and GPS. It also features ARINC 429, Ethernet access, MIL-STD-1553, AFDX/ARINC 664, video/audio H.264, video MPEG 2000/audio, HD camera and aero mic combo, and an underwater locator beacon. Width: 12.7cm Height: 10cm Weight: 2.17kg Power supply: 28V DC nominal

GENERAL DYNAMICS

MISSION SYSTEMS - CANADA

Airborne Mission Systems

General Dynamics Mission Systems - Canada is the mission system integrator for the Royal Canadian Air Force's new maritime helicopter, the Sikorsky CH-148 Cyclone (see separate entry). Its role involves the selection and integration of the mission computer, sensors and aircraft self-protection systems for the fleet of 28 aircraft. Information from radar, ESM, acoustics, data links and navigation and communication systems is fused and presented to tactical crew through the company's Tactical Integrated Sensor Information System. GD MS - Canada is also responsible for providing ground support equipment such as a software integration lab, pre- and post-mission analysis tools and training facilities, as well as the management of performance-based in-service support for 20 years. Applications: Mission systems integration Operating platforms: Sikorsky CH-148 Cyclone Systems integrated: Mission computer, sensors and aircraft self-protection systems

GENESYS AEROSYSTEMS

IDU-450

The IDU-450 3D synthetic vision EFIS from Genesys Aerosystems is a flight management system that is designed to enhance safety and reduce pilot workload. The system is designed for avionics in special mission, military trainer, commuter, light, medium and heavy-lift rotorcraft. It integrates navigation, communication and warning systems which communicate in real time to improve C2. The system has multi-function display modes which include radar, graphical flight planner, geo-referenced hover vector, data link weather and traffic, displayed on a 1,000nit LCD screen with fully adjustable brightness. Length: 127mm Height: 101.6mm Weight: 2kg Operating temperature: -55°C to +75°C

IDU-680

The IDU-680 is Genesys Aerosystems' 3D synthetic vision integrated Electronic Flight Instrument System. The system includes a Highway in the Sky navigation system, geo-referenced hover vector and graphical flight management system. The IDU-680 is also capable of recording the digital flight performance of the previous five flights, has NVIS-A and NVIS-B night vision goggle-compatibility and is certified with most existing autopilots. The system is fully digital and designed to enable aircraft-independent installation in both fixed wing and rotorcraft airframes. In March 2017, MD Helicopters announced that it had selected the IDU-680 for the avionics upgrade for its MD 902 Explorer. Length: 152.4mm Height: 203.2 Weight: 4.3kg Operating temperature: -55°C to +75°C

HISS

Surveillance Systems Integration

HISS has designed and installed complete mission systems in 24 countries around the world. These include a range of rotary- and fixed-wing aircraft, rugged ground vehicles and wide-area security networks incorporating such subsystems as airborne EO/IR, moving maps, slaved searchlights, microwave downlinks, operator consoles, ground-based tracking microwave stations, radar and integrated command centres. Applications have been in the airborne, ground, maritime and coastal environments. All equipment installed is carefully selected from a group of partner OEMs for best fit to the customer's requirements, and as most appropriate for their operational theatre. Applications: Mission systems Operating platforms: Bell 206, 412 and 430, Mi-17, Sea King, Black Hawk, MD 530F, MD 902, Fennec, BK 117

IAI ISRAEL AEROSPACE INDUSTRIES

Combat Helicopter Upgrades

IAI Lahav led the development of the upgrade package for the Mi-8 and Mi-17 helicopters along with other IAI divisions. The package utilises subsystems which were designed for the Russian Mi-35 and Ka-52 attack helicopters. IAI Ramta is responsible for the installation design of both the cockpit panels and the various avionics systems, as well as for adapting the cockpit to be NVG-compatible. The Tamam division supplies the HMOSP observation and targeting payload and the pilot 'smart' helmet. The Elta Division provides the helicopter's self-protection system with associated EW components. This upgrade package can be tailored to the specific requirements of any Mi-17 user. The upgraded Mi-17 will be capable of performing missions around the clock and in adverse weather conditions. Moreover, EW and armament packages will improve the helicopter's offensive and defensive capabilities. The Tactical Upgrade Package improves the helicopter's battlefield survivability. Ramta is also responsible for the CH-53-2000 upgrade, a Bell 212 upgrade, conversion of the Bell 206 to police operations and the new integrated avionics system for the HAL Dhruv ALH.

IAI LAHAV

Dhruv ALH Demonstrator Cockpit

The Lahav Advanced Light Helicopter (ALH) avionics system features the company's proven Display and Mission Computer with its Operational Flight Program software and is based on operational programs developed for the Israel Air Force and other customers. The ALH, with Lahav's avionics package and cockpit layout, provides integrated displays for each mission stage; optimised system management and operation; colour-coded tactical situation picture for rapid monitoring of the helicopter and its surroundings; safe day/night/adverse weather operation under all environmental conditions, including full NVG compatibility; along with maximised flexibility and growth potential utilising modular avionics with open architecture, MIL-STD-1553B data bus and other commonly used interfaces. Off-the-shelf avionics subsystems include display and mission computer; multi-function colour displays, four 8x6in LCDs; glass-cockpit features; two control and display units for data entry, flight management functions, subsystem control and system status display; Doppler/GPS for pinpoint navigation; and a radio altimeter. MIL Standards: MIL-STD-1553B data bus Display dimensions: 4x 8x6in displays

LEONARDO LAND & NAVAL DEFENCE ELECTRONICS

VigilX

The VigilX system provides enhanced situation awareness by the real-time stitching of multiple IR and visible EO sensors, to deliver a panoramic through-the-hull vision. VigilX allows operations in day, night, all weather and zero light conditions, increasing flight precision for low level flight, troop or logistic insertion, extraction, air drop and SAR operations. VigilX is compatible with a variety of displays including HMDs for eyes-out pilotage and conventional HDDs for crew and support personnel. Alternatively, a centreline patch may be displayed via a suitable HUD.

VigilX is a scalable, modular system that can be configured to meet the individual needs of specific rotary- and fixed- wing platforms as well as Unmanned Air Systems. The standard distributed aperture sensor configuration comprises four 640x480px uncooled 8-12µm IR cameras. Optional sensor configurations include the addition of an alternative IR sensor, cooled sensors and 768x512px low-light-level 450-1,100nm visible band cameras for dual-band capability with image fusion. The EO sensors may be distributed about the aircraft rather than as a clustered sensor-head group. Applications: Situation awareness Weight: <20kg MIL Standards: MIL-STD 1553B Systems integrated: EO sensors, navigation Power supply: 28V

LOCKHEED MARTIN ROTARY AND MISSION SYSTEMS

AH-1 Cobra Modernisation

Lockheed Martin's (LM's) modernisation programme enhances and extends the life of the AH-1 Cobra aircraft, while reducing the total ownership cost. AH-1 crews will have the ability to fly or fight from either cockpit position. LM provides a turnkey approach to programme management, integration, testing and product support. Following initial aircraft certification and weapons qualification, upgrade production kits can be installed by LM personnel or the customer. The product is tailored to customer needs and includes training and support services. Operating platforms: AH-1 Cobra

MH-60R/S Mission Systems

Lockheed Martin (LM) provides the digital cockpit for the USN Sikorsky MH-60R and MH-60S multi-mission helicopters, and is the systems integrator for the MH-60R platform. The MH-60R, or Romeo, is a development of the Light Airborne Multi-Purpose System MK III SH-60B. The company is integrating flight avionics systems, including the navy H-60 Common Cockpit, mission avionics systems and stores and defence systems. The Common Cockpit Avionics Suite is based on open systems architecture and COTS technology, including: four 8x10in full-colour, night vision device-capable, sunlight-readable displays; digital communications suite; common programmable keysets; integrated GPS and INS; mass memory data storage; rugged integrated mission computer. A fifth-generation mission computer, flight management computer and updated operational software are providing Romeo aircrew with increased operational capabilities. Pre-flight initialisation is simplified with LM's Joint Mission Planning System. Multi-Hypothesis Tracker/Data Fusion sees the project has migrated from AWACS to the MH-60R where it fuses radar, IFF and new sensors such as ESM, acoustics and additional off-board data, and by adding track ID classification. Airborne Mine Countermeasures include the integrating of Airborne Mine Countermeasures electronics to sensors and mine countermeasures equipment on two MH-60S test aircraft. Operating platforms: MH-60R and MH-60S Display dimensions: 4x 8x10in full colour, night vision device-capable, sunlight-readable displays

LOCKHEED MARTIN UK INTEGRATED SYSTEMS & SOLUTIONS

MCSP

Merlin Capability Sustainment Programme (MCSP) was a contract awarded to Lockheed Martin UK – Integrated

Systems in 2006 to 'future-proof' the RN's Merlin Mk 1 multirole maritime helicopter, by improving littoral and anti-surface capabilities. The £750 million ($1 billion) MCSP contract covered the upgrade of 30 aircraft from 2006-2014. Centred on a new tactical mission system and HMI, the upgrade also included a new aircraft management computer, a new NVG-compatible cockpit, an FN Herstal M3M .50cal HMG in a pod and improvements to the communications system, radar, acoustic processor and training system. Cockpit: 7x12in XGA (1024x768) flat-panel colour active-matrix LCD screens, five in a row across the cockpit and two below them in the centre console. These can all display flight information and aircraft systems data, the tactical picture, sensor data and totes. Mission consoles: each of the two mission consoles in the back have a 24in WUXGA (1,920x1,200) flat-panel colour MFD and two 12in touchscreen integrated display units. Leonardo is LM's strategic partner and major subcontractor on the MCSP programme. Leonardo provided an upgraded glass cockpit and aircraft management system, along with performing the aircraft upgrade at its Yeovil factory. Leonardo was responsible for designing, procuring and integrating a new avionics suite, including cockpit primary flight displays with touchscreen technology, as well as providing an updated communication and navigation system and all aspects of air vehicle integration. The programme incorporates more of an open systems architecture enabling easy and rapid adaptation to future requirements. Full-rate aircraft conversion at the Leonardo Yeovil facility was established in early 2012, with Merlin Mk 2s entering service in 2013 and achieving full operational capability in 2014. Operating platforms: Merlin Mk 2 Display dimensions: Cockpit – seven 12in XGA (1024x768) flat-panel colour active-matrix LCD screens; mission consoles – two 24in WUXGA (1920x1200) flat-panel colour MFD and two 12in touchscreen control and display panels

Merlin HM Mk 1

Lockheed Martin UK – Integrated Systems successfully introduced the Royal Navy's Merlin HM Mk 1 multi-mission maritime helicopter in 1999. As prime contractor, LM leads the design, development, production and testing, and manages a team of international subcontractors, including Leonardo for the manufacture of the EH101 airframe. The aircraft has an integrated mission system, which processes data from a range of onboard sensors, giving the Merlin an independent capability to search for, locate and attack submarine targets. It is this autonomous capability which makes the Merlin unique among ASW helicopters and enhances its multi-mission capabilities, states the company. The aircraft and its mission systems are managed by two computer systems, linked by dual data buses. The cockpit is designed for operation by a single pilot, with the autopilot allowing for hands-off flight for most of the mission. Normally flown by a crew of three – pilot, observer and air crewman – the Merlin is equipped with the Thomson-Marconi active dipping sonar which gives enhanced submarine detection ranges, and the GEC Marconi AQS-903 acoustic processor. All crew stations can access the management computers and operate the tactical displays. These are fed by the Blue Kestrel radar which possesses full 360° coverage and ability to track-while-scan surface contacts. It can also pass tactical information via a data link to other participating units.

NORTHROP GRUMMAN

H-1 Family of Avionics

Northrop Grumman produces a family of avionics for Bell H-1-series helicopters. The core avionics consist of navigation and digital map system – enhanced GPS/INS, air data, TACAN, ADF; communications suite – RT-1794 integrated VHF/UHF; EW and self-protection – radar warning, chaff/flare, missile warning, laser warning; full glass cockpit with HOCAS controls – common high-resolution displays, common screen formats (for core functions), common HOCAS designs (for core functions), AH-1Z full 'flight and fight' from both front and back seats, 1024x768px displays, full access/control at all locations; Expansion options include added pilot night vision system, incorporation of fire control radar, implementation of Longbow missile, image capture, compression and data link. AH-1Z unique: wing stores weapons management and control – laser-guided Hellfire, Sidewinder, 2.75in rockets, bombs/flares; 20mm Gatling gun – digital gun turret and A/G-A/A ballistics; target sighting system – third-generation FLIR, colour TV, stabilised turret; integrated helmet display and sighting system – visor projected, integral I2 cameras, accurate DC magnetic tracker. UH-1Y uniquely has a communication suite expansion – added VHF/UHF, expansion to SATCOM; night targeting and pilot sensor; centralised Avionic Mission Management Computer (AMMC) – processes, fuses, displays and controls functions; full avionic mission management computer and display redundancy, modular avionics components and modular, scalable software; AMMC developed in accordance with open architecture standards. Operating platforms: Hi-1 series including AH-1Z, UH-1Y Display dimensions: 1024x768px

ITAS

Northrop Grumman is a major producer of tactical information management systems for maritime patrol, ASW, ASuW, SAR and related applications. The Northrop Grumman AN/ASN-150 and AN/ASN-123 systems are in use with the USN and USCG, as well as a large number of international customers on such platforms as the SH-2F/G, SH-3H, SH-60F, HH-60H/J, S-70B/C and CH-124B. The latest generation in this family, known as the Integrated Tactical Avionics System, introduces the latest processing and display technologies and architectures into such applications for both fixed- and rotary-wing platforms. The company also produces a full range of mission support and integration systems to support these airborne applications. The equipment includes avionics mission management computer; H-1 integrated avionics system; integrated communications suites; integrated helmet display and sighting subsystem; integrated weapons management and control; and mission operational flight programs. Applications: Tactical information management systems Operating platforms: SH-2F/G, SH-3H, SH-60F, HH-60H/J, S-70B/C, CH-124B

RAFAEL ADVANCED DEFENSE SYSTEMS

HeliCOAT

The HeliCOAT combat helicopter upgrade suite is a modernisation package for helicopters. It enables any rotorcraft to carry out an attack mission, day or night and in adverse weather conditions. It enables the engagement of multiple targets, hard or soft, at long and stand-off range with high accuracy and improved

helicopter and crew survivability. The system includes Spike ER missiles and launcher: Toplite EO observation system; and the Jam-Air directional IR countermeasure, self-protection system. The HeliCOAT upgrade package can also include a helmet-mounted sight with night flight capability; modified cockpit; moving map; multi-function control and display unit; pilot's monitor; right and left handgrips and passive ceramic protection capability. Systems integrated: Missiles, launcher, observation system, countermeasures/protection systems

RAYTHEON SPACE & AIRBORNE SYSTEMS

A2C2S

The Army Airborne Command and Control System (A2C2S) is a command post integrated into US Army UH-60 Black Hawks. The A2C2S can also operate as an airborne or a ground tactical operations centre. It provides five workstations and the ability for the tactical commander and staff position themselves most effectively to best command and control forces during missions. It supports echelons above corps, corps, division and manoeuvre brigade commanders. The system offers up to five reconfigurable and removable user stations and two large common displays and hosts selected ABCS software programs. Open systems architecture has been implemented and it is interoperable with other C2 systems. It replaces obsolete AN/ASC-15B/C C2 consoles. A2C2S supports C2 requirements for missions ranging from humanitarian assistance to deep operations in high-intensity conflict. The system provides situation awareness and C2 through C4I digital connectivity as well as enabling the commander and his staff to traverse the battlespace to reach critical places at critical times. It also provides a LoS and NLoS voice and digital data communications package. Applications: C2 Operating platforms: UH-60 Black Hawk

ROCKWELL COLLINS

Flight2

The Flight2 integrated flight and mission management system provides increased situation awareness that enables reduced pilot workload, while enhancing flight safety and improving mission effectiveness. This fielded and combat-proven suite provides an integrated primary flight display, engine indicating and crew alerting system, flight management, communications management, vehicle management and mission management. Mission management capabilities include integrated EO/IR sensor, digital maps, data link and self-defence systems. Flight2 is scalable from two-display to five-display configuration and includes high-resolution, sunlight-readable NVG-compatible control display units and multi-functional display units (ranging from 6x8in to 9x12in viewable), data transfer systems and mission computers. Flight2 has a modular open system approach which enables future aircraft capability and technology upgrades that reduce overall customer life-cycle costs. Flight2 is currently operational and deployed on the MH-47G, MH-60M, UH-60M, CH-47F, MH-60T, S-70 and CH-53G, and has been selected for the CH-53K, AW149, International Chinook and MH-65E aircraft. Applications: Situational awareness Operating platforms: MH-47G, MH-60M, UH-60M, CH-47F, MH-60T, S-70 and CH-53G Display dimensions: Multi-functional display units ranging from 6x8in to 9x12in viewable Systems integrated: EO/IR sensors, digital maps, data link, self-defence systems

SAAB

Tactical Mission System for Helicopter Applications

The Saab tactical mission system is a system for transport, utility, C2 and combat helicopters intended to operate in a net-centric environment. It is designed to be upgraded easily and adapted to new and changing missions without interfering with the flight-critical parts of the core helicopter. The system is based on modular kits that can be quickly added to meet mission-specific needs. The system meets the most rigid requirement in the Nordic Standard Helicopter Programme and was chosen for the Swedish NH90. Saab has the overall responsibility for design development and integration, including sensor handling and data fusion. It draws on products and competencies developed in the Gripen programme and other air, land and maritime applications. The Tactical Mission System (TMS) is designed around a core 'main system computer', with application software for integration of the different subsystems such as radar, sonar, detectors and EW systems, sensor and weapons management, mission management and mission support systems. The core is built around Saab's new distributed modular avionics where the traditional electronic boxes have been replaced by standardised easily modified modules that interact over a local network. Core functionality constitutes multirole tactical mission functionalities for cockpit and crew, including a digital map, sensor handling and recording functionality and tactical communication supported by mission planning and preparation, post-flight analysis. Tactical radar IFF, tactical EO system and an EW suite will contribute to enhanced situation awareness for the pilots. A mission management system is included in the cabin, hosted in a set of consoles for the operators. Naval operations are supported by a modern acoustic system included as one of the multirole mission kits in the TMS. The TMS is NATO-compatible and can be integrated with existing C2 infrastructures as well as with secure network ground facilities. Applications: Tactical mission system for transport, utility, C2 and combat helicopters Operating platforms: NH90

SAFRAN ELECTRONICS & DEFENSE

Helicopter Modernisation

Helicopter Modernisation packages are generally based on a central computer and flight management system. They can cover a range of missions such as: observation, engagement, CSAR and special operations. Depending on need, the following units can then be added: gyro-stabilised optronics sensors, gyro-laser navigation system (SIGMA), attitude sensors (APIRS), glass cockpit, digital cartography, mission planning and post-flight analysis systems, autopilot, night and day/night cameras (FLIR), third-generation NVGs, self-protection, and data links. For military or parapublic applications, the company is involved in important programmes such as the AS350, AS565, H225M, Caracal, Tiger, NH90 and UH-72A Lakota. Operating platforms: AS350, AS565, H225M, Caracal, Tiger, NH90, UH-72A Lakota

Helipsys

Helipsys is a mission planning and debriefing system for helicopters, providing cartographic data analysis and flight data calculations (mass, centring, performance,

autonomy) using flight manual data. The system also performs trajectory calculations, taking into account all data from operational theatres, in particular the presence of identified air defence systems, with intervisibility zones according to topography. Consideration of tactical situation data is done via transfer from an operational information system, and Helipsys reads out mission planning data, also allowing for software debriefing and experience feedback. Network operation enables several helicopters' missions to be planned simultaneously and each action is instantaneously dispatched to every participant. Designed for use in joint and combined-arms foreign operations, Helipsys can be used by mounted helicopter forces on aircraft carriers. Applications: Mission preparation and debriefing system for helicopters

ICDS

The Integrated Cockpit Display System (ICDS) is a fully sunlight-readable, colour active-matrix LCD flat-panel display with optional embedded night vision imaging system. Associated with various other devices, it can offer multiple onboard functions. The system's computer processor is capable of updating all flight dynamics, engine performance, navigation information and communication data in real time. A two-display suite provides full panel instrumentation. Fitted with an MFD showing flight parameters, the system is flexible and can display video or images from an onboard sensor. The screens are ITAR-free and TSO-certified. The moving map display offers pilots further navigation data, geographical maps with mission-related overlays, and terrain elevation etc. Weather data may be uploaded to the ICDS; aviation weather products include NEXRAD, METAR, TAF, AIRMET, SIGMET, CATMET, NOTAM, Winds Aloft, Significant Weather graphical and text reports. Reports are obtained on a request/reply basis. In the US, ICDS screens equip the LA Police Department's helicopters as part of a modernisation programme. Applications: H120, AS350, Bell 206, Bell 407, S-64, R44 Power: 50W, 14-28V Display: Multi-function digital display system available in three different sizes, 264, 213 and 163mm Tracking: Requires GPS receiver but no transponder, only available when the corresponding ground-based infrastructure is in place; this function gives the aircraft or helicopter crew information with TCAS and TAWS via ARINC 708 or video inputs Operating temperature: -20°C to +70°C (storage temp: -40°C to +80°C) Operating platforms: AS350 MIL Standards: TSO C113, TSO C44B, RTCA DO-178B, AS-8034, DO160D

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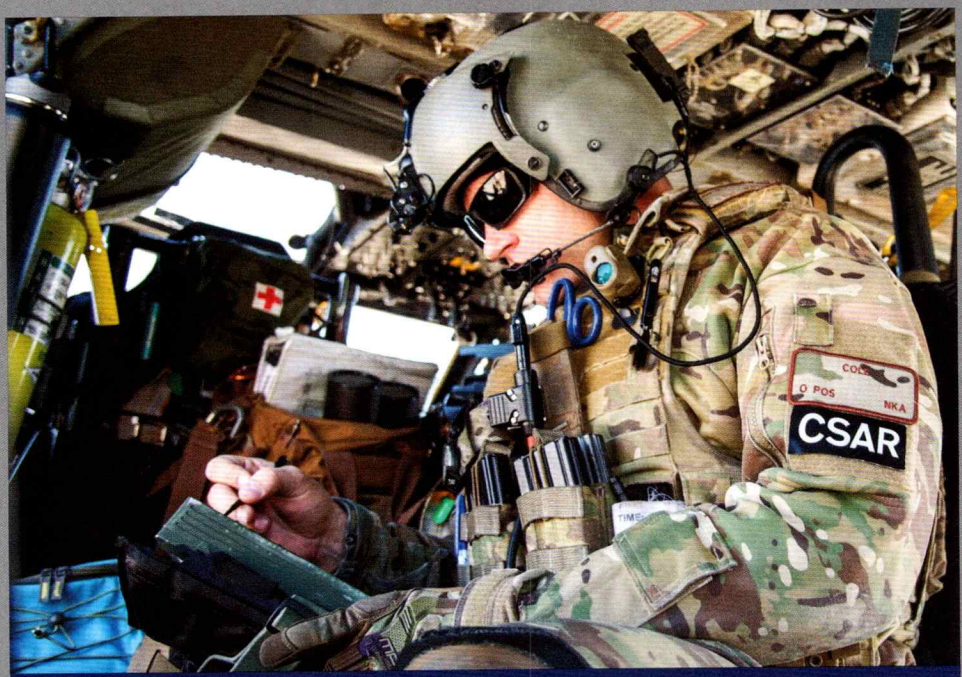


EQUIPMENT

COMMUNICATIONS

This section features a selection of voice and data communication systems optimised for use on helicopters.

Information has been supplied by the manufacturers.

If your company produces a communications system for helicopter use which you believe should be listed in this section, please contact Karima Thibou at karima.t@shephardmedia.com to ensure it appears in the Shephard Plus online database (shephardplus.com) and is included in the next print edition.

ABOVE: At Moody AFB, Georgia, airmen conduct preflight checks to ensure that the HH-60G Pave Hawk is prepared for a combat SAR mission. (Photo: USAF)

AIRBUS DEFENCE & SPACE (GERMANY)

Cryptographic Computers

The secure part of an IFF system is based on miniaturised crypto computers such as transponders, interrogators and combined transponder/interrogator. The IFF system also includes the key and time loader (DTCH) which is adaptable to specific interfaces, has a high capacity (1,000 keys) and also includes a GPS receiver. Airbus offers a range of cryptographic computers including the QRTK3A and QRTK3B, which are intended for use aboard helicopters. The main features of such cryptos are Mode 4, Mode 5 and Secure Mode and compliance with STANAG 4193. The products are certified by SECAN and AIMS and are ITAR-free. Applications: Cryptos Certifications / MIL Standards: Compliance with STANAG 4193; certified by SECAN and AIMS; ITAR-free Secure modes: Mode 4, Mode 5

ASELSAN

SDNR

Designed to provide high-speed data and voice communications to support land, marine and air platform applications on the digital battlefield. The family consists of handheld, manpack, vehicular and base station radios that are able to provide seamless communications between tactical users through secure voice, data and video. Software Defined Networking Radio (SDNR) ensures increased survivability against the EW threat by providing alternative communication means over bands ranging from 2-30MHz HF to 30-512MHz V/UHF. Software configurable architecture supports various tactical radio waveforms and advanced EPM techniques on the same platform. The SDNR provides multi-band and multi-mode secure voice and data communications and supports advanced ECCM techniques. The radios can be customised by using the built-in programmable encryption module that has the capability to support many different crypto algorithms required by different waveforms. V/UHF SDNR provides all NATO-defined tactical radio functionalities such as: combat net radio, broadband packet radio, narrowband packet radio and single-channel radio access. The V/UHF SDNR radio is claimed to be the only available radio that supports all the tactical communication functions defined by the NATO TACOMS post-2000 and to provide a wideband, high-speed data service. It is also claimed to be the only radio today that supports simultaneous voice and data using the wideband networking radio waveform (WBNR) mode, and it supports advanced data communication services. IP packet data is available up to 112kbit/s net throughout in the WBNR. The radio supports standard V.24 and Ethernet data interfaces for easy access. The V/UHF SDNR features full-duplex voice communications in the WBNR mode with tactical area communication system (TASMUS) subscribers. It can be automatically integrated with strategic and PSTN networks through TASMUS. The air platform radio operates in 30-512MHz 15W V/UHF and 2-30MHz 100W HF. When longer ranges are required for V/UHF band, a power amplifier is available to provide 50W o/p in FM mode and 30W PEP o/p in AM mode. A wideband hopping collocation filter is integrated to the power amplifier to provide co-site performance. Applications: High-speed data and voice communications Data rate: IP packet data is available up to 112kb/s net throughout in the WBNR Ports and interfaces: Standard V.24 and Ethernet data interfaces Operating range frequency: 2-30MHz HF to 30-512MHz V/UHF Secure modes: Multi-band and multi-mode secure voice and data communications

AXNES AVIATION

PNG Wireless System

PNG is a wireless ICS extension for use in and outside rotary- and fixed-wing aircraft that integrates with any vendors' existing ICS, according to the company. It provides both full duplex and secure communication and has a robust range. Patented noise reduction capabilities ensure communication under any conditions. The PNG system consists of a base station, a control panel and a number of transceivers. It is NVG class B-compliant. MP50 PNG transceiver includes GPS; outside crew position data is transferred to the aircraft. A maritime AIS-SART is incorporated within the MP50. Both position reporting and activation of the beacon may be done by the remote crew if in distress, or remotely from the aircraft. The ruggedised device is waterproof. The outside crew may also remotely access other radio resources such as TETRA, tactical or SATCOM on a separate PTT. Axnes offers two different charger types: CH50 table charger for off-aircraft use; and CH55 for airborne use. CP50 PNG control panel is designed to a DZUS 146m technical format, and can be installed on a flight deck/cabin/mission station. BST50 PNG base station is installed in the aircraft, and connected to the aircraft wired ICS. Features include analogue and digital audio interfaces, capability to deliver PTT signal to radios installed in the aircraft, an external configuration memory module, dual antenna, various serial Interfaces (ARINC429, RS232, Ethernet, CAN), full duplex, 390-470MHz (custom specified) and channel separation 12.5/25/50KHz (selectable). Secure modes: AES 256 or embedded hardware encryption Predefined frequencies: UHF and VHF

BAE SYSTEMS

AN/VRC-99A

The AN/VRC-99A is a programmable, wideband, secure, open-architecture tactical communications system providing virtual circuit and datagram service that is designed for reliable, simultaneous, multichannel voice, data, imagery and video transmission. This terminal can be configured for ground, shipboard and airborne platforms. Digital signal processing provides flexibility in end-to-end communication connectivity, packet formatting and packet switching protocols. Use of spread spectrum modulation (LPI/AJ), growth for transmit power controls (LPD) and embedded encryption provides security and integrity. The basic system provides coverage from 1,300-1,500MHz. Features include user-selectable burst rate of 156kb/s-10Mb/s with an option for fully adaptive operation; forward error correction; RAKE processing for multipath; embedded COTS IP router; frequency-hopping mode; extra RF bands available; programmability to support multiple heterogeneous networks via gateways and internet protocols; user-friendly front panel; automatic initialisation/network entry at power-on, no user setup required; TEMPEST-tested COMSEC module with networking efficiency design; and interoperable with MSE voice circuit and packet data switches. Certifications / MIL Standards: Complies with army technical architecture/ joint technical architecture Data rate: User-selectable burst rate of 156kb/s-10Mb/s Ports and interfaces: Include

RS232, RS422 with X.25 LAPB link layer and Ethernet 802.3 Operating range frequency: 1,300-1,500MHz

CUBIC GLOBAL DEFENSE

AN/ARS-6 (V12) PLS R/T

The new AN/ARS-6 (V12) Personnel Locator System (PLS) Receiver/Transmitter (R/T) is a functional replacement for the old AN/ARS-6. Retaining all the functions and backward compatibility of the original, the V12 adds several capabilities: extended and improved, high-quality two-way voice now covers entire 225-400MHz UHF band; a 360°, wideband DF antenna from Chelton Electrostatics provides accurate azimuth measurements at all angles from 110-407MHz; simultaneously monitors four channels and decodes the 406MHz Cospas-Sarsat embedded GPS position; interoperable with all US-deployed combat survival radios including the PRC-112 and CSEL PRQ-7; interoperable with all standard emergency distress beacons and Cubic's URX-3000 Tactical ELT and GPS-based survival radios. Additional data I/O includes MIL-STD-1553B, ARINC-429 and RS422 ports. It interfaces with existing aircraft PLS installations and wiring, including original hardware (CDU, RDU and ASU LRUs) and software. The lighter weight and smaller size V12 can be configured as a data bus-controlled system, making use of integrated/bused cockpits. Applications: Personnel locator Certifications / MIL Standards: MIL-STD-1553B Ports and interfaces: ARINC-429 and RS422 ports Operating range frequency: Entire 225-400MHz UHF band

AN/ARS-6(V12) PLS CSAR

Cubic's AN/ARS-6(V12) personnel locator system (PLS) is an operationally proven CSAR asset. The airborne guidance system is the latest evolution of Cubic's AN/ARS-6 PLS/LARS, used by US and NATO forces for two decades. The V12 is smaller, lighter and more powerful than its predecessor. PLS provides secure, encrypted communications between rescue forces and downed aviators during combat and civil rescue missions. It is primarily installed on rotary-wing aircraft, but also selected fixed-wing aircraft and UAVs that support the modern recovery missions. It retains all the functions and backward compatibility of the original ARS-6 (V): is interoperable with all US-deployed combat survival radios; has extended, high-quality, two-way voice communications; is a 360° wideband DF antenna, and is interoperable with all standard civil emergency distress beacons and Cubic's Tactical ELT. Applications: CSAR Operating range frequency: 225-300 MHz (Interrogation mode), 225-400 MHz (AM Voice), 118-407MHz (DF) Power supply: 5.5 Amps at 28Vdc Certifications / MIL Standards: MIL-STD-1553

CUBIC MISSION SOLUTIONS

AN/ARS-6(V12) PLS

The V12 Personnel Locator System (PLS) receiver/transmitter is a functional replacement for the AN/ARS-6. Retaining the functions and backward compatibility of the original ARS-6(V), the V12 adds several capabilities: extended two-way voice now covers the entire 225-400Mhz UHF band; an optional 360° wideband DF antenna provides azimuth measurements at all angles from 110-407MHz and decodes the 406MHz Cospas-Sarsat embedded GPS position; and the system is interoperable with US-deployed combat survival radios, including the PRC-112 and CSEL PRQ 7. It is also interoperable with standard emergency distress beacons and GPS-based survival radios. Additional data I/O includes MIL-STD-1553B, ARINC-429 and RS-422 ports. The V12 interfaces with existing aircraft PLS installations and wiring including original hardware (CDU, RDU and ASU LRUs) and software. The lighter and smaller V12 can be configured as a data bus-controlled system, taking advantage of integrated/bused cockpits. An optional common data link module is available to provide full motion video to the aircraft. Type: personnel locator system Length: 37cm Width: 13cm Height: 16cm Weight: 6kg

ELBIT SYSTEMS

ADL

The software-defined Advanced Data Link (ADL) architecture offers secure and immune multi-point communications for mobile or stationary tactical platforms. The lightweight ADL enables the transmission and reception of compressed video, telemetry and control packets at a range of up to 160km. All the data types are merged into one stream that can be encrypted and transmitted by the data link using standard IP protocols. The ADL is composed of three main components: a compact airborne data link terminal, a ground data link terminal for static and mobile ground operation, and a handheld remote video transceiver. The system combines command and control capabilities to manipulate the platform and payload, and can be operated and configured from a standard PC. Applications: Data link Ports and interfaces: Standard IP connections Data rate: 9Mbps

CNR-9000/9000HDR

The CNR-9000/9000HDR is a multi-mode VHF/FM COMSEC/ECCM radio system for voice and data communications. Capabilities include an extended communications range and error correction codes, along with automatic data rate adaptation. Equipped with MANET capability and IP-based communications, the HDR enables real-time video transmission as well as tactical e-mail, file transfer and voice over IP (VoIP) services. The frequency-hopping radio has a menu-driven MMI. An optional integrated communications controller (CC-9000) provides data services to one PC user through the COM serial interface, or group of users on a LAN. This enables users to access combat radio networks while running any of their preferred commercial applications such as email, ftp file transfers and browsers. CC-9000 extends the reach of LAN and WAN subscribers into combat area networks. Connecting CC-9000 units allows routing between different CANs, expanding voice-based networks into an advanced tactical internet radio environment. CC-9000 uses IP as its network layer protocol, allowing message routing between networks and the combat area, as well as gateways to most non-military networks. The airborne configuration ARC-906 5W/ARC-906HDR 10W/ARC-920 20W/ARC-920HDR 20W Tactical VHF enables ground-to-air and air-to-ground tactical communication. The airborne configuration system includes optional cockpit control unit (with optional NVG capability). Applications: Voice and data communications Data rate: 115.2Kbps; optional built-in voice encoding system operates at 2,400 and 4,800bps

with high intelligibility Ports and interfaces: Optional control of the radio system via MIL-STD-1553B interface Secure modes: COMSEC digital encryption facility Operating range frequency: 25Khz

MCTR-7200 MIPR

Part of the E-LynX family, the MCTR-7200 Military IP Radio (MIPR) is a tactical networking IP data radio that delivers high-speed broadband data communication to the battlefield. High-resolution video and voice services are transmitted over a decentralised mobile ad hoc network. The MIPR provides connectivity for dozens of members per network. The MIPR offers a modular range of configurations geared to match specific operational mission requirements, including vehicle configurations, as well as both airborne and marine radio sets. Applications: Broadband data communication Secure modes: Encryption technology provided Data rate: 5.5Mbps Operating range frequency: 225-512MHz

ELBIT SYSTEMS EW & SIGINT – ELISRA

Digital AN/ACQ-9 TVDL

The digital AN/ACQ-9 Tactical Video and Data Link (TVDL) is an improved version of the field-proven TVDL video and data receiver/transmitter system, says the company. Designed for deployment on attack helicopters, this video relay is interoperable with the latest remote video terminals such as Rover, OSRVT, SL-Rambo and MRS-2000. Elbit states that the low-weight system can fit in cramped cockpits. The digital TVDL displays real-time surveillance imagery and telemetry data captured by UAS payloads or ground-based sensors, as well as imagery captured by onboard payloads, directly in front of the aircrew. It securely transmits the data to tactical ground forces and other helicopters, enabling enhanced coordination and adaptive battle management. This creates a common visual language among all forces in the battlespace, reducing the time required to correlate targets and improving situation awareness, while increasing both aircrew and forward air controller comfort level during the target correlation process. The digital TVDL version allows video and data to be transmitted over a small amount of the bandwidth consumed by equivalent analogue systems, while increasing reception sensitivity, improving communication security and immunity and adding robustness against multipath and fading interference during mobile reception. Additional operational features include: data recording, retrieval and processing capabilities, IP interfacing and networking. Applications: Tactical video and data link for attack helicopters Weight: <4kg Operating range frequency: L, S, C; predefined frequencies – 16 (receive), 8 (transmit)

The Flightcell DZMx provides HF, cellular tracking in an all-in-one hybrid system. (Image: Flightcell International)

EXTANT AEROSPACE

IDM

The Improved Data Modem (IDM) is described as a flight-proven, off-the-shelf system that provides an open-architecture, multipath approach to situation awareness in the cockpit. The system is designed to improve utility and service life on existing military radio equipment. Interconnecting with up to four separate radios (HF, UHF, VHF or SATCOM), the IDM facilitates the creation of a digital transmission network for the sharing of sensor and tactical data among all coalition forces without regard to nationality, language or platform. The MD-1295/A is currently in operational service or has completed integration demonstrations on both US and international platforms such as AH-64D and WAH-64D, OH-58D, A2C2S and UH-60Q. On each of these platforms, the IDM supports missions such as suppression of enemy air defences, close air support, forward air control, air combat, joint air attack team, fire support, intra-flight data link, situational awareness data link and C2. Applications: Data modem Operating platforms: AH-64D and WAH-64D, OH-58D, A2C2S, UH-60Q Data rate: AFAPD, TACFIRE, MTS and IDL protocols

IDM-501/IDM Junior

Originally designed for UAV applications, the IDM-501 also fits into fighter/attack aircraft and helicopters. IDM-501 has the same capabilities as existing IDM systems, such as four channels of digital data communications, multiple protocols of AFAPD, TACFIRE and IDL, identical aircraft interfaces and the PRISM option for imagery, but is half the size, half the weight and generates less than half the heat. The IDM-501 can be hosted as a single card in another avionics box and will handle the MIL-STD-188-220 and VMF protocols. Memory storage capacity and type: 256MB SDRAM, 4MB SRAM, 256Kb EEPROM, 32MB FLASH. Radio interfaces: four primary channels, each can be configured for analogue (ASK, FSK) or digital (NRZ, ASK, synchronous or asynchronous) interface; one multipurpose serial port which can be configured for RS422 or RS232. This port can be used for an interface to the flight computer as a replacement to the 1553 port and can be connected to any radio. Applications: Data communications Certifications / MIL Standards: MIL-STD-810 Data rate: Analogue port data rate – 2,400, 1,200b/s; digital port data rate – 16,000, 2,400, 1,200b/s Ports and interfaces: Multipurpose serial port configured for RS422, RS232 Environmental temperature: -54°C to +71°C Operating platforms: AW159 Wildcat; T129

FLIGHTCELL INTERNATIONAL

DZMx

The Flightcell DZMx is an all-in-one hybrid satellite and cellular system for global voice, data and aircraft tracking. The Mil-Spec device supports Iridium PTT. It provides HF, low-cost cellular tracking, according to the company. The interface is designed to be easy to use, with a soft touch,

backlit silicone keypad, mis-key prevention guard, convex keys for gloved operation, and an LCD menu. The keypad and LCD backlighting is NVIS A/B NVG-compliant. The DZMx has external SIM card access ports and an optional remote head unit. The DZMx is an environmentally sealed unit that meets IP53, designed to resist the incursion of fog, water, sand and dust. Specific application products have been developed to support fire-fighting, HEMS, SAR, ALE and agriculture operations. Length: 120mm Width: 125mm Height: 55mm Weight: 0.65kg Data interfaces: USB, RS232, RS432, RS485, ARINC 429, Ethernet Certifications: DO160G Power consumption: 12-32V DC: 1A@28V DC Operating temperature range: -40°C to +70°C

Iridium Cradle

The Flightcell Iridium Satellite Phone Cradle is a lightweight alloy frame designed for the US military and rated to 16+G for military use. The cradles support 9505/9505A, 9555 satellite and extreme phones. Direct power source charges the handset and phones clip into place with a quick release mechanism. They include an inbuilt antenna connector, data and power supply connections enabling network integration. When installed in conjunction with the Flightcell DZMx (see separate entry), the satellite phone in the cradle acts as a transceiver and is controlled from the DZMx keypad in the cockpit. Length: 65mm Width: 72.3mm Height: 222mm Weight: 680-795g Power output: 4.2V-5.0V (model dependant)

HARRIS

Harris Airborne Multi-Channel Radio (HAMR)

The Harris Airborne Multichannel Radio (HAMR) is a two-channel wideband radio designed to deliver voice, high-speed IP-networked data, and full-motion video. It uses VHF/UHF networks to provide air-to-air and air-to-ground communications. HAMR enables interoperable communications between multiple waveforms and radios including the entire Harris Falcon family of radios. The HAMR solution repackages two Falcon III AN/PRC-152A radios into an airborne form factor in the same SWaP as a traditional, single-channel airborne radio. High-speed networked data and video is supported by Harris Advanced Networking Wideband Waveform and Soldier Radio Waveform. HAMR integrates two SSDLs which are certified to protect classified information. It supports BLoS communications between command and the tactical edge for users with both wideband and legacy waveforms. Applications: Air-to-air/air-to-ground communications Weight: 5kg Operating range frequency: 30-520MHz, 762-870MHz (narrowband), 225-450MHz (wideband), L-band support with optional PA Power supply: 28 VDC per MIL-STD-704 Secure modes: Sierra II Based Type 1 Encryption (Suite A/B)

HARRIS COMMUNICATION SYSTEMS

ADRA Bowman VHF/Centaur

The Advanced Digital Radio Airborne (ADRA) provides a Bowman VHF radio capability to helicopters and fixed-wing aircraft that is fully compatible with the Bowman VHF ground radio and the Bowman VHF portable transceiver. The system provides secure anti-jam voice and data facilities and operates in a shared voice/data environment using carrier sense multiple access techniques. The ADRA features MIL-STD-1553 remote control and serial RS422 control for legacy platforms without MIL-STD-1553 capability. The ADRA is derived from, and has the same installation footprint as, the ARC-201D SINCGARS airborne radio. A flexible software architecture allows the ADRA to assume a number of new roles. The Centaur VHF Airborne radio is the export version of the Bowman ADRA. Applications: digital airborne radio Length: 10cm Width: 30cm Height: 14cm Power: 24V to MIL-STD-704 Weight: 3.2kg Certifications / MIL Standards: MIL-STD-1553 remote control Ports and interfaces: RS422 control for legacy platforms

AN/ARC-201 SINCGARS

The AN/ARC-201 airborne radio, part of the Single Channel Ground and Airborne Radio System (SINCGARS) developed for US military use, provides anti-jam voice/data communication, improved error correction, enhanced data modes and improved GPS capabilities. The SINCGARS Airborne Radio's integration of COMSEC and the Data Rate Adapter (DRA) combines three Line Replaceable Units (LRU) into one—reducing overall aircraft radio weight. This Type 1 airborne solution prevents jamming and interception through noisy channel avoidance and enhanced frequency hopping, and supports future battlefield requirements with improved error correction, Enhanced Data Modes (EDMs) more flexible remote control, and GPS compatibility. Applications: Anti-jam voice/data communication Weight: 2.5kg Power supply: 28 Vdc per MIL-STD 704 Operating range frequency: 30-88 Mhz VHF-FM

HENSOLDT SENSORS

LTR 400

The LTR 400 is claimed to be the smallest and lightest Mode S/IFF transponder available worldwide. It is used for civilian ATC and military applications in order to recognise friendly units. The LTR 400 equipment set includes the transponder and the remote control and display unit. The set provides the capability of Mode S enhanced surveillance and extended squitter as defined in ED-73C and DO-260B and Mode 5 level 2 as defined in STANAG 4193. The system incorporates a built-in test designated for the detection and isolation of any module failures. Owing to these micro-features, the LTR 400 is particularly adapted to use on board UAVs, small helicopters and aircraft. Applications: blue force recognition Length: 221mm Width: 130mm Height: 24mm Weight: 2.8kg Certifications / MIL Standards: ED-73C, DO-260B, STANAG 4193 Secure modes: Mode S enhanced surveillance and extended squitter and Mode 5 level 2

IAI ELTA SYSTEMS

ARC-840D

The ARC-840D is a multi-band, multi-channel SDR featuring SCA. The system is designed and for simultaneous transmission and reception of voice and data, either by LoS or SATCOM. By implementing a common platform, the system can enclose various communication plug-in units which operate simultaneously. The ARC-840D radio set is comprised of multiple units: the ARC-840D Transceiver (R/T) with embedded GPS receiver; the control box (CB), which fits wherever required; and an optional external power amplifier (PA). Type: multi-band, multi-channel SDR Length: R/T 32cm; PA 15cm; CB 6cm Width: R/T 13cm

2-channel, 7cm 4-channel; PA 19cm; CB 12cm Height: R/T 19cm; PA 17cm; CB 15cm Power: 28V DC Weight: R/T 9kg 2-channel, 14kg 4-channel; PA 5kg; CB 1kg Waveforms: AM/FM in VHF/UHF bands Data rates: 32/128/256/512kb/s

ELK-1891 - SATCOM

The ELK-1891 is a full duplex X- or Ku-band SATCOM network, intended for uninterrupted mid-rate OTH communications (eg voice, data, compressed video). Each subscriber port of this SATCOM network can be static or ground mobile, airborne (combat aircraft, helicopters, etc) or shipborne (eg fast patrol boats). Network operation is enabled as long as all subscribers are within the same satellite footprint area. The ELK-1891 is compatible with commercial geo-stationary communications satellites, regardless of waveforms (eg QPSK/BPSK; coherent demodulation; TDMA over CDMA). A typical terminal comprises three main units: the antenna unit, the transceiver and the power amplifier. The antenna is tailored to specific platform applications, such as 25x10cm planar array for mobile/airborne users, or 80cm diameter dish, both on a dual-axis stabilised pedestal. Antenna pointing is autonomous, based on external navigation data. Type: full-duplex Ku-band SATCOM on-the-move network Power: 800W Weight: 24kg Range: up to 128Kbps Operating range frequency: Ku or X band Antennas: mobile: 25cmx10cm planar array or 80cm diameter dish, both on dual-axis stabilised pedestal, having a controller with pointing capability.

ELK-1894

The ELK-1894 on-the-move SATCOM system is designed to enable bi-directional wideband communications data links for airborne, maritime and ground vehicular platforms, typically deployed for government, military and commercial applications. The mobile terminal is suited for special mission platforms such as reconnaissance aircraft, maritime patrol aircraft, AEW&C, tactical or MALE UAVs, maritime vessels and ground vehicle applications. Each terminal comprises three main units: the tracking antenna unit, the transceiver unit and a power amplifier. A variety of reflector antennas of different sizes can be selected according to carrying platform constraints. The SATCOM data link is compatible with commercial Ku-band geo-stationary communications satellites, regardless of waveforms. It complies with ITU spectrum density regulations, even for the smallest antenna size. The ELK-1894 employs communication waveforms, including spread spectrum and forward error-correction techniques. The antenna unit has four-axis tracking, able to operate above the equator with high elevation angles on board agile aircraft. Type: on-the-move SATCOM system Weight: 35-40kg (respective to antenna size) Data rate: 256kb/s max outbound/inbound Antennas: 46-83cm Operating range frequency: Ku (optional X or Ka)

RAFAEL ADVANCED DEFENSE SYSTEMS

RAVNET-300

The RAVNET-300 is an integrated VHF/UHF voice and data network, supporting airborne combat operations. It is a multi-band, multi-function, jam-resistant communication system that is designed to provide instantaneous voice and high-capacity data communication between aircraft (air-to-air) and ground terminals (air-to-ground). Features include multi-mode UHF and VHF analogue AM/FM and digital radio, with backward compatibility to existing radio systems; ad-hoc networking and automatic relay; FEC; and voice and data availability, overcoming terrain communications obstacles (suitable for low-flying platforms such as helicopters and transport aircraft). Multiple voice interface support includes standard analogue or E1, G.711 or compressed voice and H323/SIP VoIP standards. Support for avionics and non-avionics aircraft is provided via MIL-STD-1553B data bus interfaces or dedicated control box. The system has a high MTBF. Type: VHF/UHF voice and data network Length: 29cm Width: 125.cm Height: 17cm Weight: 7.5kg Certifications / MIL Standards: MIL-STD-1553B data bus interfaces Operating platforms: helicopters and transport aircraft MTBF: >1,500h Operating range frequency: VHF, UHF Data rate: up to 300kb/s

RAYTHEON

AN/ARC-231 Skyfire

The AN/ARC-231 Skyfire is an airborne VHF/UHF/LOS and DAMA SATCOM system. This system supports US DoD requirements for airborne, multi-band, multi-mission, secure anti-jam voice, data and imagery transmission and provides network-capable communications. The AN/ARC-231(V)(C) is fully qualified to appropriate military standards through environmental, reliability, electromagnetic interference (EMI)/ electromagnetic compatibility (EMC) and Joint Interoperability Test Command (JITC) testing that ensures interoperability across the tactical environment. In addition, the AN/ARC-231(V)(C) is air-worthiness certified. The ARC-231 is a software-definable radio, allowing implementation of upgrades via PC-based software downloads, even while the equipment is installed within the operational platforms. These advanced capabilities provide a solid foundation fulfilling current and future communication requirements. The RT-1808A/AN-ARC-231(V)(C) is currently used on a wide variety of platforms, which, along with a wide variety of additional users, utilise the ARC-231 for VHF/UHF LoS single-channel and SATCOM BVLOS for voice and data transmission. Applications: Secure anti-jam voice, data and imagery transmission Operating platforms: MH-60L/M, UH-60L/M, MH-47E/G, CH-47G, UH-1N, A2C2S UH-60, AH-6 Certifications / MIL Standards: MIL-STD-1553 or Serial Control Secure modes: IPV4, COMSEC, ADC Operating range frequency: 30-512MHz

ROCKWELL COLLINS

AN/ARC-210 Gen5

A software-programmable V/UHF radio system, the AN/ARC-210 multi-mode integrated communications system provides two-way multi-mode voice and data communications in either normal, secure or jam-resistant modes via LoS or SATCOM (Dedicated, DAMA, IW). The ARC-210 family of equipment comprises several variants of the receiver-transmitter and associated ancillary products, each providing a specific combination of functionality to meet user platform requirements. Using all-digital design, surface-mount technology, and modular upgradeable construction, the ARC-210 family of SDRs support multiple waveforms, applications, and platforms. Synthesiser speed and rapid radio response time handles multiple ECCM algorithms and link requirements. This family of radios offers waveform interoperability with other V/UHF radio systems and is compatible with Link 11, Link 4A, IDM and ATHS. It

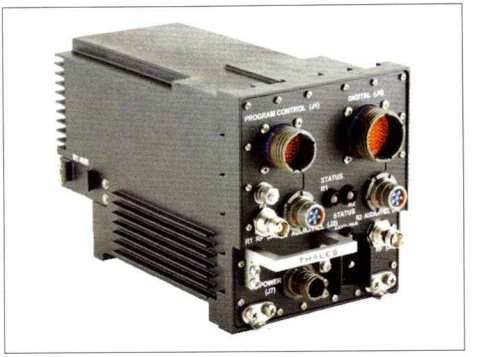
is software-reprogrammable in the field via MLVS for rapid system integration and growth. The AN/ARC-210 is the USN and USAF standard V/UHF airborne communications system, as well as, being utilised by the other US DoD branches and allies. On 14 February 2018, Rockwell Collins announced that the airborne V/UHF radio passed military security requirements for operation with the US DoD's new Mobile User Objective System (MUOS). The sixth-generation ARC-210 RT-2036 radio passed 'Do No Harm' (DNH) testing carried out by the Space and Naval Warfare Systems Command. According to the company, the ARC-210 the only airborne radio on the market to have completed testing using the most current MUOS waveform. Length: 25cm Width: 12.7cm Height: 14.2cm Weight: 6kg Coverage: 30-941MHz Data rate: 80,000b/s

AN/ARC-210V Talon

A software-programmable VHF/UHF radio system, the AN/ARC-210 multimode integrated communications system provides two-way multimode voice and data communications over the 30-1850MHz frequency range in either normal, secure or jam-resistant modes via LoS or SATCOM, including DAMA, IW, and MUOS. The ARC-210 family of equipment comprises several variants of the receiver-transmitter and associated ancillary products, each providing a specific combination of functionality to meet user platform requirements. Using all-digital design, surface-mount technology, and modular upgradeable construction, the ARC-210 family of SDRs supports multiple waveforms, applications, and platforms. Synthesiser speed and rapid radio response time handles multiple ECCM algorithms and link requirements. This family of radios offers waveform interoperability with other V/UHF radio systems and is compatible with Link 11, Link 4A, IDM and ATHS. It is software-reprogrammable in the field via MLVS for rapid system integration and growth. The AN/ARC-210 is the USN and USAF standard V/UHF airborne communications system and is used by the other branches of the US armed forces and allies. On 21 February 2018, Rockwell Collins announced that it has developed a smart mount that will provide users of the ARC-210 with added SATCOM capability through the Iridium network. Accessing Iridium's network of 66 Low Earth Orbit (LEO) satellites, users are able to maintain true global coverage, including polar regions, while simultaneously maintaining full use of the ARC-210 radio's standard capabilities. Applications: Multimode voice and data communications Data rate: 80kb/s offered with bandwidth efficient advanced modulation technology Operating platforms: MV-22, CV-22, AH-1W, MH-53, CH-46, AH-64, MH-60S/R, UH-60, Canadian CH-148, Australian Tiger

FlexNet

FlexNet, developed by Thales and Rockwell Collins Government Systems, is an SDR which acts as a foundation for network-enabled capability. FlexNet allows a mobile ad hoc transverse network to be set up quickly, delivering an on-the-move communications capacity with more than 150 fully mobile nodes at data rates of up to 6Mb/s, says Thales. It complements legacy transmission systems, implementing a transmission backbone with networking layers to offer robust and secure multimedia services including voice, IP data, video, mail and file transfer. Self-forming and self-healing, FlexNet is designed to implement adaptive routing over a distributed system. The high data rates and low latency of the FlexNet waveform



The Thales Multi-channel, Multi-band Airborne Radio has integrated VoIP capability and allows remote C2 via its hosted web-packaged graphical user interface. (Image: Thales)

also support the requirements of ISTAR and weapon systems. Nodes and internal networking functions extend the user connectivity up to HF and VHF networks and command LANs, delivering services up and down the C2 chain and horizontally across cooperating units of action. FlexNet enables real-time configuration of the radio system with the desired waveform and services. New open architecture, SCA-compliant and wideband-programmable hardware capacities make FlexNet scalable, and allow communications to progressively ramp up frequency diversity, data rates, connectivity and interoperability. FlexNet products are designed to host NATO, coalition and national waveforms with the appropriate levels of security. FlexNet expands this potentiality by integrating standardised waveforms (both Mil-Std and STANAG) over an extended frequency band for joint and allied interoperability; the system also supports legacy waveforms and anode functions to guarantee a smooth transmission from existing systems to full software radio communication capabilities. FlexNet also draws on standard IP technology to ease integration with applications such as battle management systems. Certifications / MIL Standards: Mil-Std and STANAG Data rate: Up to 6Mb/s Operating range frequency: NATO, coalition and national waveforms

HF-9000D/HF-9000F

The HF-9000 family of full-frequency HF systems is designed for use on a range of fixed- and rotary-wing airborne, transportable, shipboard and fixed-site applications. The integrated multi-mode system provides data communication capability, including text, graphics and GPS position reports. Embedded system functionality includes MIL-STD-188-141B, ALE, MIL-STD-188-110B, data modem functionality, independent sideband data operation and ARINC 714-6 SELCAL decoding with growth capability for future HF waveforms. The HF-9000D/F is compatible with the requirements of MIL-STD-188-203-1A for Link 11 data communications. BIT equipment is utilised for diagnostic testing and monitoring. The systems operate throughout the standard HF radio spectrum, providing HF communications capability anywhere in the world, says the company. The lightweight HF airborne systems are versatile, DSP-based HF radio communications systems that provide a single integrated system solution to current and future HF voice and data communications

requirement. The HF-9000F is the newest addition to the HF-9000 product line. It is suited to those requiring full MIL-STD-461D and MIL-STD-704A compliance. This ruggedised variant of the HF-9000D provides vibration and shock tolerance in a lightweight, compact system to an altitude of 55,000ft. Type: full frequency HF radio family Range: 2.0000 to 29.9999 MHz Data rates: Up to 19.2Kb/s Certifications / MIL standard codes: MIL-STD-810E, MIL-STD-461D, MIL-STD-188-110B Operating platforms: fixed- and rotary-wing airborne, transportable, shipboard and fixed-site applications. Channels: 6 pre-programmed emergency channels, 36 user-programmable channels, 249 maritime preset channels Environmental temperature: -40°C to +55°C

TruNet

TruNet is a software-defined network communications system, including ground, airborne and handheld radios; networking waveforms; apps; ancillaries; and services. It is designed to provide secure connectivity between ground and airborne elements. The system gives ground and airborne forces the ability to share secure images, voice and video communications in real time. The system is tailorable to meet mission-specific needs, including tactical, border patrol, SAR, disaster response etc, from using a few handheld radios to a full ground-to-air network. Support is also configurable, including kits that enable programmers to port mission-specific, legacy, SCA-compliant waveforms across the customer's assets.

TTR

Offered through Data Link Solutions (DLS) – Rockwell Collins' joint venture with BAE Systems – TacNet Tactical Radio is claimed to be the smallest form factor Link 16 SDR terminal. TTR is a single-channel Link 16 solution that maximises capability and simultaneously reduces complexity, cost, weight and integration issues such as cooling, typical of multi-channel radios, states the company. Rockwell Collins designed the TTR specifically for military aviation missions and applications. It provides SWaP-constrained platforms with situation awareness during operations. The TTR is designed to be interoperable with all Link 16 networks, including JTRS Link 16 platforms. It can operate in austere military environments, including high shock and vibration levels, extreme temperatures and other environmentally challenging conditions. Applications: Tactical radio Weight: <4.5kg Secure modes: Near real-time, jam resistant data

SAAB

ACMS

Airborne Communications Management System (ACMS) is a control and display system for the management of aircraft communications and radio navigation equipment, integrating digital audio and equipment control facilities. With the integrated, military-qualified, civil-certified ACMS, communications can be configured for all management requirements in any aircraft, states the company. It is flexible and future-proof, and features audio, radio and radio-navigation equipment management, enabling the generation, integration and management of aircraft audio warning signals. Applications: Aircraft communications management Weight: 1.9kg Power supply: 25W at 28Vdc Environmental temperature: -40°C to +70°C Certifications / MIL Standards: MIL-STD-810E, MIL-STD-461E, RTCA DO-160E, RTCA/DO-178B

THALES

ARC-6999 MMAR

The Multi-channel, Multi-band Airborne Radio (MMAR) repackages two AN/PRC-148 JTRS enhanced multi-band inter/intra team radios into an airborne-qualified air transport rack-style enclosure targeted at airborne VHF/UHF communications/relay payload applications. It supports dual-independent radios or retransmission with cross-banding configuration. With integrated co-site filtering, the MMAR is well suited to reduce interference from other emitters on the platform. With its integrated VoIP capability, it is able to integrate into airborne networks, allowing remote C2 via the MMAR's hosted web-paged GUI. Applications: Airborne VHF/UHF communications/relay payload Predefined frequencies: 2x 30-512MHz Channels Certifications / MIL Standards: NSA Type 1 Certified (KOV-1482) Power supply: 28V DC per MIL-STD-740F Environmental temperature: -40°C to +60°C

NextWave

The TRA 6030-N NextWave is a VHF/UHF EPM airborne SDR terminal designed to increase operational capability across new and existing platforms. Covering the 30-600MHz band, it offers full joint/combined interoperability and enables new services and an extended communications spectrum. It supports data transmission rates of up to 250kb/s to enable network-centric warfare services, such as intranet, imagery on-demand, image transmission, video and tactical data link (LX16). Nextwave features full digitisation of modem and radio processing to implement advanced modulations and network protocol stacks, adding flexibility to ease platform integration and lower evolution costs. EPM features include UHF national-specific fast frequency hopping (voice, LX16), UHF NATO standard HQ one and two, and SATURN, EPM Link 22, VHF tactical for joint/combined interoperability (PR4G Fastnet, others on demand). It also features embedded, programmable national-specific and NATO COMSEC. NextWave terminal is already fitted on board different types of helicopters, fighters and mission aircraft. Data rate: Up to 250kb/s Operating range frequency: 30-600MHz band Data rate: Multi-mode capabilities, including high-data mode

VIASAT

ViaSat Mobile Transceivers

ViaSat Mobile Transceivers and network are designed to provide improvements in situation awareness through faster position location information rates and C2 communications across the battlefield compared to the US Army/USMC legacy BFT system. Paired with a scalable, adaptable network and ground infrastructure, tactical users are able to increase their situation awareness, send tactical messages, report enemy positions, and prevent blue-on-blue fratricide. The US Army began fielding BFT-2 in April 2012 after a $71 million follow-on order was placed for systems in March 2011. With BFT-2, network users around the world can achieve real-time position accuracy by operating through a ground vehicular transceiver or aviation transceiver globally. The average round-trip message latency through the network has been demonstrated to be less than 2s. Manufacturers / contractors: ViaSat

EQUIPMENT

SENSORS

A selection of major electro-optical and infrared sensors, radars and sonar systems now in service on military helicopters or under development for rotary-wing applications.

Systems are listed in alphabetical order by manufacturer.

Equipment is split into three sections:

- EO and IR systems
- Radars
- Sonars

If your company produces a sensor system for helicopter use which you believe should be listed in this section, please contact Karima Thibou at karima.t@shephardmedia.com to ensure it appears in the Shephard Plus online database (shephardplus.com) and is included in the next print edition.

ABOVE: A US Army CH-47 Chinook helicopter carrying marines lands at Fort Greely, Alaska, after a simulated raid on Indian Mountain radar system as part of Exercise *Arctic Edge* in March 2018. (Photo: USMC)

EO/IR SYSTEMS

ASELSAN

ASELFLIR-135

The ASELFLIR-135 is a multi-sensor thermal imaging system that consists of a high-resolution, third-generation 3-5µm IR camera, colour day TV camera, laser rangefinder and laser pointer. All sensors and electronics are mounted on stabilised gimbals housed in a single 28cm turret unit. IR Sensor Type: 3-5µm IR camera

ASELFLIR-200

The ASELFLIR-200 airborne EO system is a multi-purpose, TI sensor for pilotage/navigation, surveillance, SAR, automatic tracking, target classification and targeting. It uses open architecture with a flexible hardware/software unit which can be adapted to various naval, ground and air platforms, the latter including rotary- and fixed-wing and unmanned. The payload comprises the IR camera (incorporating a scanning LWIR FPA detector), a colour CCD camera and an eye-safe laser rangefinder. The system is available in single-, dual- and triple-sensor configurations including IR only; IR and colour CCD; IR and LRF; and IR, colour CCD and LRF. Other features include electronic image stabilisation; local area processing for image enhancement; multi-mode tracking using area or centroid modes; analogue and digital video outputs for transmission and/or recording; MIL-STD-1553/ARINC and other discrete data buses to interface with onboard avionics such as radar, navigation and weapon systems. Applications: ISR and targeting Certifications/MIL Standards: MIL-STD-1553/ARINC

ASELFLIR-235

The ASELFLIR-235 is an enhanced multi-sensor targeting and surveillance system. It consists of a high-resolution, third-generation 3-5µm IR camera, high-resolution day TV camera, spotter camera, laser rangefinder/designator, laser spot tracker and laser pointer. All sensors are mounted onto four-axis stabilised gimbals housed in the 43.2cm turret unit. The system has multiple target tracking capability over all images. The eye-safe laser rangefinder/designator is in the turret. ASELFLIR-235 can provide precise target co-ordinates, target direction, target velocity information and automatic alignment using an embedded inertial measurement unit. The laser spot tracker is used to lock on a laser spot designated by an external source. The night vision-compatible laser pointer is used for target pointing. IR Sensor Type: 3-5µm IR camera

ASELFLIR-300

The ASELFLIR-300 Advanced Targeting System is a multi-sensor EO targeting and surveillance system for airborne and naval platforms. The system consists of an LWIR scanning, high-resolution IR camera, laser rangefinder/designator, laser spot tracker, colour TV camera and colour spotter camera. All sensors are mounted onto four-axis stabilised gimbals housed in a 50.8cm turret. The system has multiple target tracking capability over three (IR, TV, spotter) sensor feeds. The laser rangefinder/designator can designate targets with desired PRF codes. The laser spot tracker is used to lock on a laser spot designated by an external source. ASELFLIR-300 can provide target co-ordinates, attitude and velocity. The system can automatically align itself with the platform by using transfer alignment algorithms and embedded IMU data. Operating platforms: airborne and naval platforms

CONTROP PRECISION TECHNOLOGIES

A-View

The A-View is a lightweight EO/IR gyro-stabilised payload installed on helicopters and fixed-wing aircraft for night mission support purposes. It was designed for observation and surveillance at close ranges. The A-View incorporates an IR continuous-zoom lens operating in observation mode, providing real-time IR video, and day TV CCD is optional. It has optional navigation capability with point-to-co-ordinate and hold co-ordinate modes. Operation and control of the A-View is by a PC (laptop), portable control and display unit, or any other C2 system. The A-VIEW is being phased out of production. Applications: flight safety, assistance during poor visibility conditions, clear landing pad verification, clear tail rotor and cargo hangar Power: 12 or 24V DC Stabilisation: 3-gimbal, gyro-stabilised system, 2-axis motion (elevation and azimuth) Turret dimensions: 17.7cm (dia) x 23cm (H) Operating temperature range/temperature tolerance: -10°C to +50°C Field of regard azimuth: nx360° (slip ring) Turret length: 230mm Payload weight: 3.2kg Control: PC (laptop), a portable control and display unit or any other C2 system Field of regard - pitch from horizon: +10°/-100° Platforms: helicopters, fixed-wing, UAVs Turret width: 180mm LOS - Angular Velocity Azimuth: 60°/s LOS - Angular Velocity Pitch: 30°/s

DSP-1

The Dual Sensor Payload – 1 (DSP-1) is a day/night observation system for helicopters, light reconnaissance aircraft, UAVs and patrol boats. The four-gimbal system is gyro-stabilised in azimuth and elevation for the entire field of regard, including at the nadir/zenith point. The DSP-1 interfaces with external devices such as moving maps, C4I systems, radar and navigation systems using standard communication channels. The system has automatic target tracking, built-in image enhancement and local AGC capabilities. Height: 483mm Power: 28V DC, power consumption 110W Weight: 22.5kg Detection range: 25km (day TV, IR); recognition 10km (day TV), 7.5km (IR) Diameter: 330mm Vibration endurance: 2.5g, 5-2,000Hz FOV widest: IR 27x20.6° (wide) continuous; daylight 13.6x10.2° (wide) Zoom - optical: IR up to 22.5x; day 20x continuous Daylight channel: high-resolution colour CCD camera with 768x494 element chip Video output: NTSC or PAL Pointing accuracy: 0.5° Turret height: 480mm FOV narrowest: IR 1.2x0.9°; daylight channel 0.7x0.52°, gain control is automatic IR sensor: FOX 450 3-5+µ InSb, 320x256 element FPA with up to 22.5x continuous optical zoom lens Interfaces: dual parallel output (TV, IR), GPS interface, 1553 and ARINC 429 interfaces Options: FOX 720, 36x continuous IR zoom lens, narrowest FOV 0.76x0.59°, extended maritime environment, low temperature, laser pointer, 1.5x extender for TV zoom lens, eye-safe LRF Field of regard azimuth: unlimited Temperature range: -20/+50°C Turret width: 330mm Field of regard elevation: +70/-115° Zoom - electronic: 0.6x0.45° Focal length - IR: 720mm LOS stabilisation: 4 gimbals stabilise turret in azimuth and elevation to better than 20µrad RMS

DSP-HD

The DSP-HD is a medium- to long-range EO/IR camera payload. The compact dual-sensor day/night observation system is designed for use on helicopters, light aircraft, UAVs and patrol boats. Sensors include a TI, HD zoom camera, HD daylight spotter channel and optional LRF and laser pointer. The four-gimbal system is gyro-stabilised in azimuth and elevation for the entire field of regard, including at the nadir/zenith point. The DSP-HD interfaces with external devices such as moving map, C4I systems, radar and navigation systems using standard communication channels. The system supports automatic target tracking, continuous optical zoom, built-in image enhancement and local AGC capabilities. Geo-pointing, location and tracking are optional. Applications: border patrol, SAR, surveillance; patrol boats, helicopters, light reconnaissance aircraft, UAVs, aerostats Height: 500mm Power: 28V DC, 100W Diameter: 350mm Electronic zoom: 36x (TI) Video interfaces: HD-SDI (1080p), PAL/NTSC, DVI (1080p) Field of regard elevation: +70/-110° Thermal imager type and wavelength: 640x512 3-5µm InSb FPA Laser rangefinder: optional Class I (eye-safe), 1.54µm Laser rangefinder max range: 75m-20km Payload equipment box dimensions: 21x21x15.6cm Payload equipment box weight: 3.6kg, optional 1.5kg Laser pointer: optional 0.83µm, 75mW MIL standard codes: MIL-STD-461, MIL-STD-810, MIL-STD-704 Turret weight: 28kg Daylight camera type: 1,920x1,080p 2MP colour HD camera: 1,920x1,080p colour daylight spotter channel Optical zoom: 3x (TI); 3x (daylight HD); 3x (daylight spotter) Field of regard azimuth: nx360° continuous

FOX-1400

The FOX-1400 TI camera has continuous optical zoom lens, image enhancement capabilities and auto-focus through zoom. This long-range observation IR camera includes local AGC algorithms, remotely controlled zoom and focus adjustment and black or white hot polarity. Gain/level control is automatic, manual or local AGCTM. Length: 407mm Width: 265mm Height: 280mm Power: 28V DC, 40W Weight: 11kg FOV - narrow: 0.4° Cooling system: closed-cycle Stirling cooler FOV - wide: 13.7° Lens type: continuous optical zoom 35x Lens aperture: 250mm Optical zoom: 35x Shock levels/ratings: 20g, 11m/s, 1/2 sine Spectral IR band: 3-5µm Operating temperature range: -20°C to +50°C Cooldown time: 8min (nominal) Vibration levels: 2.5g to 2,000Hz Resolution: 640x512px Focus: automatic adjustment through zoom Reporting: zoom position, calibration and BIT status Focal length: 1,400mm (max) Camera generation: Gen III InSb FPA

LDP

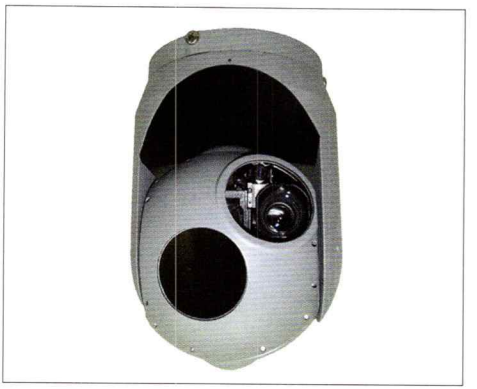
The LDP stabilised payload is a day and night designator/observation system for targeting missions configured for use on UAVs, helicopters and marine patrol boats. The four-gimbal system is gyro-stabilised in azimuth and elevation, allowing the EO sensors' LOS to be aimed and maintained, stabilised in any orientation in the field of regard, independent of the platform's attitude and motion. Sensors include a TI, CCD or full HD camera, LRF/laser designator and optional laser pointer. The LDP interfaces with external devices such as moving map, C4I systems, radar and navigation systems using standard communication channels. The system has automatic target tracking, built-in image enhancement and local AGC capabilities. Height: 570mm Power: 28V DC, power consumption 110W Weight: 3.5kg PEB (2kg optional) Diameter: 350mm Stabilisation: 4-gimbal system Temperature range: -20°C to +50°C Laser capability: designator/rangefinder - 80MJ energy, 1.06µm wavelength, 15km range measurement FOV widest: CCD TV - 13.6x10.2°; FOX 720 TI sensor - 27x20.6° FOV narrowest: CCD TV - 0.7x0.52°; FOX 720 TI sensor - 0.76x0.57° IR sensor: FOX 720 TI sensor - 3-5µm spectral band, 36x continuous optical zoom lens, 27x20.6° widest FoV, 0.76x0.57° narrowest FoV Options: 640x512px FLIR detector; hand control unit; 213, 264 or 381mm ruggedised display; DVR; three-CCD TV - high-resolution colour three-CCD, 800 TV lines, 20x zoom lens Platforms: UAVs, helicopters, patrol boats Field of regard elevation: +70/-110° Field of regard azimuth: nx360° continuous Daylight channel: CCD TV - high-resolution colour camera, 768x494 pixels, 20x zoom lens

QUAD-Air/HD

The QUAD-Air is a compact day/night observation system configured for UAV, light aircraft, helicopter and marine patrol boat applications. The system comprises three gyro-stabilised gimbals. Sensors include TI, CCD camera, optional LRF and optional laser pointer. The QUAD-Air also has an automatic target tracker, built-in image enhancement and local AGC capabilities. QUAD-Air is operated by a ruggedised control unit with a thumb LOS control stick, designed for rough environmental conditions. The control unit can be attached to a fixed location or be movable via a flexible cable. The QUAD-HD has the same configuration and capabilities as the QUAD-Air, with HD imaging and an optional laser illuminator. Applications: UAV, light aircraft, helicopter and marine patrol boat applications; SAR, border patrol Width: 30.5cm (dia) Height: 43cm Power: 28V DC, 70W Laser rangefinder accuracy: +/-5m Field of regard elevation: -105/+30° Laser rangefinder - type: 1.54µm Field of regard azimuth: nx360° continuous Angular acceleration - elevation: 60°/s Operating temperature range/temperature tolerance: -32°C to +55°C Zoom - optical: 12.5x (TI); 17x (day) Angular acceleration - azimuth: 60°/s IR/TI Camera type: FPA 640x512 InSb Daylight channel: high-sensitivity colour (HD) 1920x1080p day camera IR/TI Camera spectrum: 3-5µm Data interfaces: RS-422, ARINC 429 (optional), MIL-STD-1553 Zoom - electronic: 37.5x (TI); 50x (day) Turret weight: 21.5kg Laser rangefinder - range: 75m-20km Focal length - IR: 250mm

SHAPO-Air/HD

The SHAPO-Air is a multi-sensor, gyro-stabilised observation payload intended for a range of platforms, including helicopters, light aircraft, UAVs, patrol boats, aerostats/airships, armoured vehicles and high masts. Sensors include a TI, colour TV camera and optional LRF and laser pointer. Features include an automatic video tracker and video processing software, including image enhancement, correlation, centroid and prediction. The QUAD-HD has the same configuration and capabilities as the QUAD-Air, with HD imaging. Applications: day, night and adverse weather missions including observation, surveillance, ALE, SAR, homeland security, force protection and as a gunsight Stabilisation: 3-gimbal gyro-stabilised system Laser pointer: 0.8µm Payload equipment box weight: 3.5kg Turret weight: 10kg FOV - narrow: 1.75x1.3° (TI); 1.8x1.4° (day) Daylight camera type: high-resolution CCD with continuous optical zoom lens Operating temperature: -20°C to +50°C Zoom - optical:



The T-STAMP is an EO gyro-stabilised miniature airborne payload with an IR camera, GPS and laser pointer. (Image: Controp Precision Technologies)

12.5° continuous (TI) Angular coverage - elevation: +35/105° Thermal imager type and wavelength: cooled 3-5µm, 480x384 InSb FPA detector Angular acceleration - azimuth: 60°/s Turret dimensions: 24(dia)x35(H)cm Data interfaces: RS-422, ARINC 429 (optional) and MIL-STD-1553 FOV - wide: 21.8x16.3° (TI); 40x28.5° (day)

T-STAMP

The Triple-Sensor Stabilised Miniature Payload (T-STAMP) is an EO gyro-stabilised airborne system designed to be carried by small civil or military helicopters, UAVs and fixed-wing aircraft for tactical 'over-the-hill' day/night reconnaissance. The IR camera uses cooled or uncooled technology and is operated by a portable control and display unit. The system has ruggedised built-in INS on LOS, GPS integrated with INS, and a laser pointer. The T-STAMP can operate in a range of modes: observation (joystick rate), inertial target tracking, hold co-ordinate (optional), point-to-co-ordinate (optional) and scan/mosaic (optional). Applications: day and night observation for small helicopters, fixed-wing aircraft, UAVs Power: 12V DC Mounting diameter: 102mm Nose mount roll (degrees): nx360° Options: T-STAMP-C IR cooled camera or T-STAMP-U IR uncooled camera Nose mount elevation nadir: +70/-40° Laser capability: optional laser pointer Payload weight: 2.8kg Temperature range: -100°C to +45°C Turret dimensions: 17.8(dia)x27.4(H)cm Mountings: mounting diameter 178mm; mounting flexibility: horizontal nose mount, vertical belly mount Belly mount azimuth: nx360° Belly-mount elevation from horizon: +10/100°

ELBIT SYSTEMS INTELLIGENCE AND ELECTRO-OPTICS - ELOP

DCoMPASS

The Digital Compact Multi-Purpose Advanced Stabilised System (DCoMPASS) is one of the newest members of Elbit Systems' stabilised EO CoMPASS family. It is currently in service with customers across the world and was selected for the UK Watchkeeper UAV programme. DCoMPASS is a stabilised EO payload which has a digital open architecture with day and night ISTAR capabilities in harsh weather conditions. It is a single-LRU system integrating up to five elements: high-magnification zoom TI; an HD colour TV camera with optional low-light mode; an eye-safe LRF; a laser target illuminator; and laser target designator. DCoMPASS is designed to be lightweight and compact, permitting additional payload and fuel capacity in the carrying platform and facilitating future upgrades. Its embedded IMU provides navigation capabilities including geolocation. The system has diode-pumped target designation and range measurements with an in-flight boresight mechanism. DCoMPASS has multiple communication protocols and integrates with HUD systems, radar and fire control applications. The video-enhancement package includes haze penetration, colour restoration and picture sharpening. DCoMPASS is part of Elbit Systems' CAESAR avionics suite for CSAR missions. Applications: airborne day and night ISTAR Weight: 33-38kg Diameter: 380mm Certifications/MIL Standards: MIL-STD-810 Laser rangefinder: 1.54µm, rate 1pps Camera types: large format digital CCD colour Angular coverage - azimuth: nx360° Angular coverage - elevation: +35/-85° Display resolution: 1,394x1,040px (HD TV); 640x512px (TI) Platforms: UK Watchkeeper UAV Laser designator: dual-wavelength 1.64/1.57µm Interfaces: Gigabit Ethernet, RS-485, RS-232, RS-422; integrates with HUD systems, radar and fire control applications Data interfaces: RS-422, MIL-STD-1533, Ethernet Laser capability: dual-wavelength laser designator/rangefinder, laser target illuminator and laser spot tracker Laser target illuminator: 830nm Thermal imager: FLIR cooled Gen III 3-5µm

MicroCoMPASS

Micro CoMPASS is an 8in (203mm) EO payload system for small UAVs and other platforms, including airborne, maritime and ground, providing day and night intelligence and surveillance capabilities, including in harsh weather conditions. The three-gimbal configuration provides LOS stabilisation. The turret includes four major sensors – continuous-zoom TI, colour TV camera, eye-safe LRF and laser target illuminator – integrated into one LRU. Features: compact size and light components; miniature cooled continuous-zoom IR camera; stabilisation level; laser target rangefinder; laser target illumination; multiple communication protocols; meets operational requirements of marine and low-altitude aerial applications; designed for 'fast and easy' maintenance, according to the company. Applications: surveillance, and reconnaissance, force and convoy protection, law enforcement Weight: <9kg Diameter: 21cm Angular coverage - azimuth: 360° Day channel: 1/4in CCD detector camera Laser target illuminator: 830nm Thermal imager type: 640x512px, 3-5µm FPA Electronic zoom: 12x FOV widest: 42x32° Laser designator: optional FOV narrowest: 1.7x1.2° Operating platforms: small UAVs; airborne, maritime and ground vehicles Angular coverage - elevation: +30/-85° Laser rangefinder: eye-safe, 1.54µm, rate 20ppm Video output: PAL, NTSC Data interfaces: RS-232/422, Ethernet

SWORD

The Surveillance and Warning Obstacle Ranging and Display (SWORD) is an eye-safe laser radar designed for helicopters. It is used for detection of man-made and natural obstacles with warning time greater than 8s at a flying speed of 170kt. With 100° field of regard, the system 'looks into the turn' and can provide an alert at least 8s before collision even in a sharp turn. The

system provides alerts only for obstacles that endanger the helicopter. SWORD has the capability to work in brownout mode for low-visibility landing conditions. Applications: surveillance and warning obstacle ranging and display Data interfaces: ready for integration with various display means such as HMD, HUD, HDD and digital map Field of regard: 100°

FLIR SYSTEMS

BRITE Star II

The BRITE Star II is the latest version of the combat-proven BRITE Star laser designation system. The system includes a five-FOV, large-format TI which has a variable zoom setting and a three-FOV three-chip colour daylight camera. The diode-pumped laser designator/rangefinder is compatible with US and NATO laser-guided munitions, including Hellfire missiles. The system also includes a laser pointer and laser spot tracker. Automatic inflight boresighting capability is intended to reduce pre-flight preparation, ease switching between aircraft and allow the operator to boresight the system at any time. An inertial measurement and navigation processor supports pointing and steering at high zoom levels. The BRITE Star II features a multi-mode adaptive tracker which locks onto, and holds, moving and stationary targets independent of platform motion. The BRITE Star II has been selected for US DoD and FMS programmes. Applications: reconnaissance and long-range targeting system Power: 22-29V DC per MIL-STD-704E Stabilisation: 4-axis FOV - Optical: 30-0.31°; day camera matched to IR Laser rangefinder: Class 1 (eye-safe) Magnification: 97x Day channel: 3-chip colour CCD TV Data interfaces: RS-232, RS-422, ARINC 429, MIL-STD-1553B, Ethernet Laser pointer: 640mW, Class 4 Operating temperature: +55/-40°C Laser rangefinder max range: 20km Thermal imager type: 640x512 InSb FPA Turret dimensions: 410x490mm Turret weight: 54.4kg Certifications/MIL Standards: MIL-STD-810F, MIL-STD-461E Laser designator: 1.06µm NdYAG Class 4 Components: TI, colour CCD TV, laser designator/rangefinder/pointer Laser rangefinder accuracy: +/-5m Spectral band: 3-5µm

Star SAFIRE 230-HD

The Star SAFIRE 230-HD provides up to seven simultaneous payloads in a single-LRU 9in (229mm) package, including IR, HD colour CCD, EMCCD, laser pointer, laser illuminator, LRF and embedded IMU/GPS. The system includes an integrated control module and can be repositioned between aircraft without the need to change a separate electronics box or reroute main sensor cables throughout the fuselage. The system has fibre-optic gyro-stabilisation, a digital video interface and the common interface standard of the Star SAFIRE family. The identical cable set, hand controller and GUI gives the ability to change to other sensors based on mission needs, without the need to retrain system operators. Applications: reconnaissance, surveillance and targeting Power: 18-32V DC, 280W nominal, 308W (max) FOV - Optical: 21.7-0.6° (IR); 12-0.6° (day) Data interfaces: MIL-STD-1553, ARINC 429, Ethernet, RS-232, RS-422 Day channel: 1280x720 HD colour CCD; 811x580 high sensitivity CCD (low light) Laser rangefinder max range: 20km Laser target illuminator: Class 4, 2W, 830nm IR Sensor Type: 640x512 InSb MWIR FPA Certifications/MIL Standards: MIL-STD-810, MIL-STD-461 Payload weight: 19kg Laser pointer: Class 3b, 135mW, 830nm Zoom - optical: 18x (IR); 10x (day) Spectral band: 3-5µm Zoom - electronic: 36x (IR); 20x (day) Video interfaces: digital SMPTE-292M, analogue SMPTE 170M (RS-170) Laser rangefinder: Class 1 (eye-safe), 1,540nm

Star SAFIRE 260-HLD

The Star SAFIRE 260-HLD is a lightweight, gyro-stabilised turret that provides up to seven payloads simultaneously, including IR, HD colour CCD, low light, diode-pumped laser designator, laser illuminator/pointer, LRF and optional IMU/GPS. The sensor uses video auto tracker and other workload reduction technologies. This system can be run standalone or as an integrated sensor in a range of platforms. Applications: ISR, targeting Power: 18-32V DC Laser rangefinder: Class 1 (eye-safe) Day channel: 1920x1080 HD colour CCD TV; 640x480 low light Data interfaces: MIL-STD-1553, ARINC 429, RS-232, RS-422 IR Sensor Type: indium antimonide FPA (MWIR) Laser rangefinder max range: 30km Payload weight: 24.9kg Certifications/MIL Standards: MIL-STD-810, MIL-STD-461 Laser designator: Nd:YAG 1.06µm Laser pointer: Class 4, 1.9W, 830nm Zoom - optical: 18x (TI); 10x (day) Video interfaces: SMPTE 292M, RS-170 Zoom - electronic: 2x

Star SAFIRE 275-HD

The Star SAFIRE 275HD is a lightweight and compact gimbal with all European content, single LRU for ease of installation and integration, digital HD output for all video channels and IMU for precise geolocation. The system, which can operate in all-weather conditions, can be delivered with EASA Form 1 certification. The Star SAFIRE 275HD provides standardised wiring to all Star SAFIRE HD turrets in this family as well to external systems, making this family of systems completely interchangeable and interoperable. Applications: counter drug, homeland security, patrol, surveillance, reconnaissance, SAR Height: 378.5mm Power: 22-29V DC per MIL-STD-704E Weight: 15kg Turret width: 275mm (diameter) Payload weight: <44kg FOV - Optical: 45° to 2.2° Options: auto-tracker, laser range finder, laser pointer, laser illuminator, IMU, control unit

Star SAFIRE 380-HD

The Star SAFIRE 380-HD is a digital HD, gyro-stabilised single-LRU imaging system featuring six-axis stabilisation with high-magnification optics. Sensor and geospatial data is embedded within the digital video stream, so there is no need for separate dedicated ports. The system has HD-SDI video channels with symbology overlay, an optional SWIR payload for expanded multispectral imaging and multiple laser payloads. The image processor core provides AGC, auto-focus, filtering, edge enhancement and optional real-time image blending. The common interface of the Star SAFIRE family provides standardised wiring for all HD turrets and interoperability with external systems. Width: 38cm (dia) Height: 47.5cm Power: 22-29V DC per MIL-STD-704E Weight: 45kg including all options Laser rangefinder - type: Class I (eye-safe) Daylight channel: colour CCD, progressive scan Max air speed: 405kt IR/TI Camera type: 640x512 InSb MWIR FPA (standard); 1280x720 (optional); InGaAs (SWIR) Data interfaces: RS-232, RS-422, ARINC 419/429, MIL-STD-1553B, Ethernet Operating temperature range/temperature tolerance: -40°C to +55°C IR/TI Camera spectrum: 3-5µm Certifications/MIL Standards: MIL-STD-810E, MIL-STD-461F Zoom - optical: 120x FOV - medium: 30-0.25° (TI); 55-1.5° (low-light) IR/TI Camera resolution: 720-1080px HD and NTSC/PAL Laser pointer/

illuminator - class/type: 150mW (Class 3b) or 650mW (Class 4b) (pointer); 1W or 2W, Class 4 (illuminator) Laser rangefinder - range: 25km

Star SAFIRE 380-HDc

The Star SAFIRE 380-HDc is a stabilised HD imaging system, designed to maximise ground clearance on rotary aircraft. The image processor core provides image quality with AGC, auto-focus, filtering, edge enhancement and optional real-time image blending. Spotter optics extend DRI range and the SWIR sensor expands imaging capability in degraded visual conditions, penetrating through smoke, haze and pollutants. Sensor and geospatial data is embedded in digital video, so there is no need for syncing with separate data ports. The Star SAFIRE 380-HDc system has an HD TI, a colour CCD camera, a dual-view secondary HD colour camera, an MTI and AR map options. Multiple laser payload options include rangefinders, illuminators and target markers/pointers. The Star SAFIRE 380-HDc is compatible with existing SAFIRE installations for upgrades and/or mixed fleet operations. Applications: ISR, SAR, maritime patrol, targeting, border patrol, UAVs, force protection Width: 38cm (dia) Height: 35.3cm Power: 22-29V DC per MIL-STD-704E Resolution: 720p/1080p HD and NTSC/PAL Options: navigation/radar interfaces, quick-disconnect mounts, HD displays and recorders, moving map systems, HD downlinks MIL standard codes: MIL-STD-810E, MIL-STD-461F IR sensor type and wavelength: InGaAs progressive global (SWIR) 3-5µm Thermal imager type and wavelength: InSb MWIR FPA 1280x720 (standard); 640x512 (optional) Operating temperature: -40°C to +55°C Daylight camera type: colour CCD, progressive global Laser rangefinder max range: 30km Laser pointer: 150mW Class 3b or 650mW Class 4b Laser illuminator - power: 1W or 2W, Class 4 Turret weight: 28kg Laser rangefinder: Class 1 (eye-safe) Mounts: compatible with existing SAFIRE installations Data interfaces: RS-422, ARINC 419/429, MIL-STD-1553B, Ethernet

Star SAFIRE 380-HLD

The Star SAFIRE 380-HLD is an all-digital HD system which provides image stabilisation, long-range imaging, metadata embedded in digital video, and laser target designation. Designed for military fixed-wing and helicopter operations, it is military-qualified and features six-axis stabilisation with high-magnification optics. The image processor core provides AGC, auto-focus, filtering, edge enhancement and optional real-time image blending. The system features a single-LRU configuration, high bandwidth HD-SDI video channels with symbology overlay, and multiple laser payloads. Inflight boresight confirms alignment in under 30s, and the optional SWIR payload offers expanded multispectral day and night imaging. The simplified common interface of the Star SAFIRE family provides standardised wiring for all HD turrets and to external systems for interchangeability and interoperability. Applications: ISR and targeting Power: 22-29V DC per MIL-STD-704E Turret width: 380mm Laser rangefinder: Class 1 (eye-safe) Turret height: 480mm Day channel: colour CCD, progressive scan Data interfaces: RS-232, RS-422, ARINC 419/429, MIL-STD-1553B, Ethernet Zoom - optical: 120x Operating temperature: -40°C to +55°C Laser rangefinder max range: 20km IR/TI Camera resolution: 720p/1080p HD and NTSC/PAL IR Sensor Type: 1280x720 InSb MWIR FPA (standard); 640x512 (optional); InGaAs (SWIR) Laser target illuminator: 1W or 2W, Class 4 Max air speed: 405kt FOV - Optical: 40° to 0.35° (TI); 29° to 0.25° (CCD) Certifications/MIL Standards: MIL-STD-810E and MIL-STD-461F IR/TI Camera resolution: 3-5µm Payload weight: 48kg Laser pointer: 150mW (Class 3b) or 650mW (Class 4) Laser designator: 1.064µm, up to 20Hz, Class 4 Components: 640x512 MWIR, SWIR sensor, laser rangefinder, pointers and illuminators, inflight automated boresight module, navigation/radar interfaces, quick-disconnect mounts, HD displays and recorders, moving target indicators, moving map systems, HD downlinks

Star SAFIRE HD

The Star SAFIRE HD is an all-digital, HD, gyro-stabilised imaging system. It is military-qualified and has six-axis stabilisation. The system includes thermal, daylight and low-light cameras with high-magnification optics, laser payloads and an integrated IMU for target location. The Star SAFIRE HD has high-bandwidth HD-SDI video channels with symbology overlays and multiple laser payloads. The image processor core provides AGC, auto-focus, filtering, edge enhancement and optional real-time image blending. Cable compatibility allows operators to upgrade existing Star SAFIRE family installations to HD. Power: 22-29V DC per MIL-STD-704E Laser rangefinder max range: 20km MIL standard codes: MIL-STD-810E, MIL-STD-461F Laser pointer: Class 3b, 100mW Laser illuminator - power: Class 4, 1W or 2W options Daylight camera type: colour CCD TV, progressive scan Optical zoom: 120x (TI, CCD); 36x (low-light camera) Payload weight: 44.5kg including all options Mounts: compatible with existing SAFIRE systems Laser rangefinder accuracy: +/-5m Resolution: 720/1080 and NTSC/PAL Data interfaces: RS-232, RS-422, ARINC 419/429, MIL-STD-1553B Thermal imager type and wavelength: 640x512 InSb FPA 3-5µm

Star SAFIRE III

The Star SAFIRE III is a military-qualified COTS multi-purpose, gyro-stabilised airborne platform carrying seven payloads. The system offers image fusion, five-axis stabilisation, automated operation and aircraft integration features. Matched multi-FOV optics maintain situational awareness while achieving long-range and enabling image blending. Cable compatibility allows operators to upgrade existing SAFIRE-family installations with plug-and-play. The Star SAFIRE III can be used with an optional three-chip colour CCD spotter scope. Over 500 Star SAFIRE IIIs have been delivered to the US military, NATO and nations worldwide. Applications: ISR, target acquisition Power: 22-29V DC per MIL-STD-704E Laser pointer: Class 3b Zoom - electronic: 12x (CCD TV) Spectral band: 3-5µm Day channel: colour CCD-TV Laser rangefinder: Class I (eye-safe) Max air speed: 405kt Operating temperature: -40°C to +55°C Data interfaces: RS-232, RS-422, ARINC 419/429, MIL-STD-1553B Platforms: land force protection, shipboard open ocean and littoral patrol, long-range airborne reconnaissance FOV - Optical: 25-0.35° (TI); 28-2.7° (CCD TV) Thermal imager type: InSb FPA Laser rangefinder max range: 25km Payload weight: <44kg Laser target illuminator: Class 4 Zoom - optical: 71x (TI); 18x (CCD TV) Certifications/MIL Standards: MIL-STD-810E, MIL-STD-461F Laser rangefinder accuracy: +/-5 m

Talon

The Talon is a gyro-stabilised 9in (229mm) turret that can be housed in a range of mounting positions. Designed to

meet mid-range RSTA mission requirements, it contains up to six payloads simultaneously, including IR, colour CCD, EMCCD, laser pointer or illuminator, LRF and embedded IMU/GPS. The Talon is available in a multi- or single-LRU configuration, with workload reduction features such as scan mode, video auto tracking and auto gain/level. The system can be used standalone or in interfaces through purpose-built software that enables connectivity to moving maps, radar and search light systems. Applications: ISR and targeting Power: 18-32V DC Weight: 14.5kg IR/TI Camera type: indium antimonide FPA Data interfaces: MIL-STD 1553, ARINC 429, RS-232 RS-422 Slew rate: 0-140°/s Laser pointer/ illuminator - output: 135mW (pointer); 1.9W (illuminator) Laser pointer/illuminator - class/type: Class 3b (pointer); Class 4 (illuminator) Zoom - optical: 10x continuous, 18x overall (TI); 25x continuous (colour CCD); 10x continuous (low light) Laser rangefinder - type: Class I (eye-safe) Data output/video format: analogue and digital (SMPTE) Laser pointer/illuminator - wavelength: 830nm IR/TI Camera resolution: 640x480 Laser rangefinder - range: 20km Turret width: 0.23m (Dia)

Ultra 8500

The Ultra 8500 is a military-qualified, stabilised turret with triple-payload capability, optimised for light to medium fixed- and rotary-wing aircraft. The system provides real-time automatic image optimisation, an embedded multimode autotracker and icon-based colour graphical overlay. Applications: ALE, SAR and surveillance missions Width: 22.9cm (dia) Height: 34.2cm Power: 19-32V DC Weight: 13kg FOV - wide: 21.7x16.9° FOV - ultra narrow: 1.2x0.9° with 1.8x extender employed Daylight camera type: CCD Laser pointer: Class 3b Slew rate: up to 65°/s Video interfaces: RS-170, NTSC, PAL Thermal imager type and wavelength: 320x240 InSb FPA, 3-5µm FOV - narrow: 2.2x1.65° FOV - medium: 8x6°

GENERAL DYNAMICS MISSION SYSTEMS

V-14-HS

The V-Series offers gyro-stabilised EO/IR and HD gimbal systems, providing real-time, day and night situational awareness and long-range threat detection. With searchlight controls, laser illuminating and geo-pointing functions, the V-Series camera systems can help detect and identify entities, and determine if a threat is hostile. The V14-HS camera system includes a high-sensitivity 3CMOS sensor for high-contrast colour imagery in dark, misty and foggy conditions. The gimbal incorporates noise reduction, de-haze and IR-pass functions. The gyro-stabilised platform enables close observation of a subject from stand-off ranges with image stability. Applications: airborne ISR Length: 50.8cm Width: 33cm Height: 12.7cm Power: 25-32V DC; 245W consumption Stabilisation: 5-axis gyro-stabilised system Video interfaces: SMPTE 292M and NTSC/PAL; 1080/59.94i, 1080/50i Laser rangefinder: erbium glass Data interfaces: RS-232, RS-422, Ethernet Slewing rates: 55°/s Turret coverage in elevation: +20/-195° Turret coverage in azimuth: 360° continuous Laser rangefinder max range: 20km Turret dimensions: 50.3(H)x37.8(dia)cm Interfaces: geo-pointing; autotracker; searchlight interface; moving map interface; remote control interface; image enhancement Turret weight: <38.5kg Zoom - electronic: 1.1-10x (0.1x step)

V-14-LRx

The V-Series offers gyro-stabilised EO/IR and HD gimbal systems, providing real-time, day and night situational awareness and long-range threat detection. With searchlight controls, laser illuminating and geo-pointing functions, V-Series camera systems help detect and identify entities, and determine if a threat is hostile. The V14-LRx is a dedicated 'spot ball' imaging system, which has high-magnification, continuous zoom optics for the IR and daylight video channels. It is designed for stand-off range. The V14-LRx has integrated MISB-compliant metadata and geo-pointing, geolocation and geo-targeting. Image exploitation software includes north centring, scene lock, geodetic registration, multi-target tracking and mosaic composite imagery. Applications: military, ALE Stabilisation: 4-axis Zoom - electronic: 2x Day channel: 1920x1080 daylight 2/3in 3-CCD sensor Turret coverage in elevation: +20/-195° Slewing rates: 0-30°/s Turret dimensions: 50.5(l)x37.8(w) x50.3(h)cm Turret coverage in azimuth: 360° continuous Turret weight: 36.7kg Thermal imager type: 640x480 (1920x1080 digital) MCT FPA Spectral band: 3-5µm Payload weight: 12.2kg; system weight <56.7kg (with standard cables) Video interfaces: HD-SDI, NTSC/PAL Interfaces: IMU; geo-pointing; video auto-tracker; moving maps; remote control

V-14HD

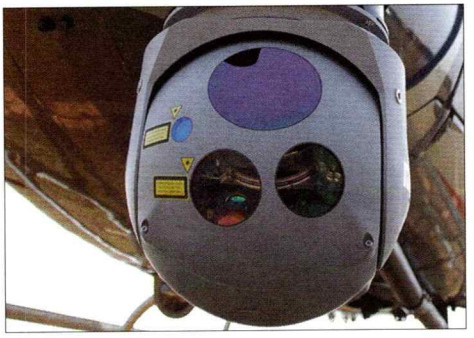
With a five-axis gyro-stabilised gimbal assembly, the V-14HD is designed to provide 1080p HD imagery with high stability. The system's capture device, the Sony HDC-1500, provides high-colour clarity and resolution for improved target identification at long range. The V-14HD has interchangeable lens options and can be easily integrated into existing systems. Width: 50.29cm Height: 37.84cm Stabilisation: 5-axis gyro-stabilised gimbal assembly Display resolution: 1080p HD Payload weight: 29.5-33.6kg

HENSOLDT OPTRONICS GMBH

Argos-II HD/ HDT

The ARGOS-II HD airborne multi-sensor observation system's main features include a continuous-zoom HD multispectral camera and an HD Gen III TI for situational

The Goshawk-II HD airborne observation and targeting system has a thrid-generation MWIR TI, HD TV zoom camera and laser rangefinder. (Photo: Hensoldt Optronics)



awareness at day and night. It also has an internal IMU and GPS for geo-functions, real-time onboard image processing and a multiple video and communication interface with onboard ancillary equipment. Argos-II HD can be installed on fixed- and rotary-wing aircraft as well as UAVs and aerostats. Its ruggedised design is engineered for harsh environments and operations so that it can be deployed on airborne platforms for maritime missions. Argos-II HDT offers the same feature set and options, but also includes a laser designator. Applications: airborne surveillance/observation and targeting Length: 495mm Width: 410mm Power: 22-32V DC, 440W (650W max) Turret coverage in azimuth: 360° continuous in azimuth Thermal imager: Attica Gen III MWIR; 3-5µm, progressive scan, continuous zoom Turret stabilisation: 4-axis, <10µrad stabilisation Platforms: rotary-wing, fixed-wing and aerostat, maritime surveillance and patrol, military reconnaissance, tactical UAV, MALE UAV Payload weight: <45kg Laser rangefinder: eye-safe, 80-20,000m Turret coverage in elevation: +20/-120° in elevation Laser pointer: power output 100mW (red), 60mW (NIR), wavelength 637nm (red), 808nm (NIR) FOV - Optical: 19.5-1.2°, continuous zoom Turret weight: <50kg (fully equipped)

Goshawk-II HD/HDT

The Goshawk-II HD/HDT airborne observation and targeting system consists of an integrated stabilised turret assembly that houses all sensors and electronics in a single unit. It is designed for medium-to-low-altitude, smaller-dimension, low-mass-applications such as small fixed-wing aircraft, helicopters and UAVs. The sensor pack contains the Attica third-generation MWIR thermal imager, HDTV zoom camera, laser rangefinder or laser designator/rangefinder. The Goshawk-II has digital image enhancement, laser designator and optional GEO functions and GPS. Applications: ISR and ISTAR Length: 450mm Weight: <14kg Turret stabilisation accuracy: <30rad Turret coverage in elevation: +20/-120° Temperature range: -30/+50°C operational, -40/+60°C non-operational Day channel: HDTV camera, continuous zoom Turret stabilisation: 4-axis Display resolution: HD 1280x720px Turret coverage in azimuth: 360° continuous Thermal imager type: 3–5µm, continuous zoom Platforms: small fixed-wing aircraft, helicopters and UAVs Payload weight: <30kg Altitude: 13,100ft operational, 19,700ft non-operational Turret width: 350mm Airspeed: 155kt operational, 240kt non-operational Laser rangefinder: class 1 eye-safe

LEO-II-A5 EP

The LEO-II-A5 EP airborne observation system is a COTS, gyro-stabilised platform containing a multi-sensor payload and a laser pointer available simultaneously in the turret. Equipped with up to three long-focal-length optical sensors, the LEO-II-A5 EP enables surveillance from high altitudes and large slant distances. It provides extended video downlink coverage and covert surveillance capabilities. According to Hensoldt, this system provides the operator with high picture performance during all operational conditions, enhancing safety and covert surveillance. The LEO-II-A5 EP includes a video auto-tracker, MAPS geo-pointing capability, searchlight slaving interface, NVG compatibility and multiple video outputs with symbology overlay. Applications: ALE, paramilitary, SAR Daylight camera type: colour TV; wide-spectrum spotter TV (colour and B&W) Communication interfaces: ARINC 429 Laser pointer: optional Video interfaces: RS-232, RS-422 Electronic zoom: 8x (TI) Thermal imager type: Gen III, 3-FOV LWIR with pseudo colours and isotherms functions Resolution: 640x480p

IAI TAMAM

LOROS

The Long-Range Observation System (LOROS) is designed for surveillance and intelligence missions. Sensors include third-generation 3-5µm thermal imager, colour CCD with zoom lens, B&W: CCD with spotter lens, intensified CCD camera and laser rangefinder. It includes an automatic target tracker, enhanced image processing and long-range downlink of video and data. Applications: ISR; fixed-wing aircraft, helicopters Power: <700W Thermal imager type: third-generation 3-5µm thermal imager Payload weight: 85kg

M-19 HD

The M-19 HD is a multi-sensor gyro-stabilised payload designed for various platforms and implemented as a single LRU. It provides real-time video in addition to targeting capability and can be equipped with up to seven sensors simultaneously, configured for day and night monitoring in all weather conditions. It is designed to provide high acquisition ranges and image processing capabilities. The system offers full coverage of the lower hemisphere, including the nadir point and automatic day/night target area tracking for two targets. The M-19 HD has a multi-mode automatic video tracker and provides geolocation using its embedded IMU/GPS and has dynamic range enhancement. Sensor configurations are tailored to requirements. Sensors include: HDTV (1920x1080) camera and 3-5µm HDIR sensor, both with wide to medium FOV, continuous zoom and a spotter for narrow FOV. Laser payloads include an eye-safe LRF, laser pointer, laser illuminator (in NIR) and electron-multiplied CCD camera or SWIR camera. Applications: UAVs, helicopters, fixed-wing aircraft, vessels, ground applications Width: 576mm Height: 694mm Power: 1,250W average Weight: 75-85kg depending on configuration Data interfaces: RS-422/Ethernet; HD-SDI, H264; NTSC/PAL (option) IR Sensor Type: HDTV (1920x1080) camera and 3-5µm HDIR sensor

MiniPOP/MiniPOP-D

The Miniature Plug-In Optronic Payload (MiniPOP) is a dual-axis, gyro-stabilised payload designed for a variety of airborne, maritime and ground, and manned and unmanned applications. The system is built on a single-LRU open architecture and carries up to four sensors. An automatic TV tracker is also installed. The MiniPOP-D (Designator) model is also available, which provides the additional capability of target designation and eye-safe rangefinding. It is compatible with US and NATO laser-guided munitions. Applications: ISR and targeting Width: 21cm (dia) Height: 28-34cm (depending on configuration) Weight: ~6.2-7.5kg Field of regard elevation: +40/-110° Day channel: CCD colour with NIR Laser rangefinder: 1.54µm (eye-safe) Laser pointer: optional 0.83µm Field of regard azimuth: nx360° Zoom - electronic: 2x (day) FOV - Optical: 2-22° (TI); 2-45° (day) Zoom - optical: 22.5x (day) IR Sensor Type: cooled InSb 3-5µm

MOSP-3000 HD

The Multi-Mission Optronic Stabilised Payload (MOSP)-3000 HD is an optimised family of four-gimbal stabilised EO payloads for various platforms including UAVs, helicopters, fixed-wing aircraft, vessels and ground applications. MOSP provides real-time video, geo-location and geo-pointing, in addition to targeting capability and can be equipped with up to five sensors configured for day and night observation and targeting. Full coverage of the lower hemisphere, including the nadir point. Automatic day and night target tracking, applying centroid or edge tracking techniques. MOSP3000-HD is equipped with a true HD TI detector (1,280x1,024px) with continuous zoom for the night channel and full HD TV detector (1,920x1,080px) with continuous zoom for the day channel. Laser capability: eye-safe LRF or designator/rangefinder. Laser pointer and IMU on gimbal are available as options. Applications: UAVs, helicopters, fixed-wing aircraft, vessels, ground Width: 350mm (UAVs), 380mm (other platforms) Height: 555mm (UAVs), 500mm (other platforms) Power: <200W Weight: 29-33kg depending on sensor configuration Slew rate: 60°/s Options: laser pointer, IMU on gimbal IR/TI Camera spectrum: 3-5µm InSb FPA Field of regard elevation: +30/-100° Data interfaces: RS-422, Ethernet Laser designator: 1.064µm IR/TI Camera resolution: 1280x1024 Magnification: 1.3-35° continuous zoom (TI) Daylight imager: 1,920x1,080 HD day TV Field of regard - pitch from azimuth: nx360° (unlimited) Video output format: HD-SDI, SDI, H-264; NTSC/PAL Laser rangefinder - type: 1.54µm (eye-safe) Laser pointer: 830nm

NTS/NTSA

Night Targeting System (NTS)/NTS Advanced (NTSA) is an upgrade of the AH-1 Cobra family's TOW sight. It can designate for Hellfire and other laser-guided weapons. NTSA deletes optical relay tube. Turret angular acceleration 60°/s. TV autotracker: min target dimensions 3x3px, min target contrast 2%, max relative velocity 1 FOV/s. Operating modes: prediction, adjust, offset. NTS is built in the US by Kollsman. Applications: targeting Day channel: 780x576px frame transfer CCD sensor with 3x FOVs; option to add a colour continuous zoom TV camera Components: thermal imager, TV camera, laser rangefinder/designator Slewing rates: turret: 2-90°/s Turret coverage in azimuth: 90° left and 95° right Thermal imager type: 240x4px, mercury cadmium telluride, 8-12µm scanned detector with time delay integration; option for third-generation 3-5µm FLIR Payload weight: 129kg excluding installation kit Operating platforms: AH-1 Cobra family Turret coverage in elevation: +30/-60°

POP-300 Family

The Plug-In Optronic Payload (POP-300) is a small EO/IR/laser payload for manned and unmanned airborne, land or maritime platforms and for coastal surveillance applications. POP-300 carries sensors in interchangeable 'slices' mounted on a gyro-stabilised turret. The system's electronics are contained within the turret. Available configurations include: POP-300 with a 640x480 thermal imager, colour CCD with near-IR capability and a laser pointer. An eye-safe LRF is optional. POP-300-I with a 640x480 thermal imager with better optics, colour CCD with better optics and near-IR capability and a laser pointer. An eye-safe LRF is optional. POP-300LR (Observer) with a 380x480 or 640x480 thermal imager with a long-range zoom lens, a colour CCD with a long-range zoom lens, a wide-angle CCD and an optional eye-safe LRF. POP-300D (Designator) with a 640x480 thermal imager, colour CCD with near-IR capability and a laser pointer, an eye-safe LRF and a laser designator (compatible with US and NATO laser-guided munitions including Hellfire missiles). POP-300D-HD is equipped with true HD thermal imaging detector (1280x1024px) for the night channel and full HD TV detector (1920x1080px) for the day channel. With better optics and near-IR capability and a laser pointer, an eye-safe LRF and a laser designator (compatible with US and NATO laser-guided munitions including Hellfire missiles). Automatic video tracker for thermal and CCD channels is a standard option on POP-300 models. Video output: PAL or NTSC. MTBF is 2,000h. Interface: RS-422. Accessories: monitor, VCR, data link, hand control unit, interface with weapon systems, GPS, radar. IMU on gimbal (option). Applications: ISR and targeting Height: 380mm (turret) Power: <200W Weight: 16-18kg depending on sensors Diameter: 260mm (turret) Field of regard elevation: +25/-90° Interfaces: RS-422, Ethernet IR Sensor Type: 640x480 TI (POP-300, POP-300D, POP-300LR); 1,280x1,024 3-5µm InSb FPA (POP-300D-HD) Day channel: 1,920x1,080 CMOS 1/3in HD colour with NIR Laser rangefinder: 1.54µm (eye-safe) Options: monitor, VCR, data link, hand control unit, interface with weapon systems, GPS, radar Slewing rates: 60°/s IR Sensor Type: monitor, VCR, data link, hand control unit, interface with weapon systems, GPS, radar Video interfaces: HD-SDI, H-264; NTSC/PAL Laser pointer: 830nm Zoom - optical: 1.7-32.6° continuous (day) MTBF: 2,000h FOV - Optical: 6x discrete FOVs from wide (29x23°) to super-narrow (0.86x0.5°) (POP300D-HD) Operating platforms: airborne, land, maritime

L3 WESCAM

MX-8

The MX-8 is a compact, multi-sensor, multispectral imaging system in a single-LRU configuration. It is the smallest of Wescam's MX-Series, suitable for manned or unmanned airborne platforms. The MX-8 was developed in response to demands from military users across Africa, the Middle East and South America for a light sensor with high-performance imaging. It was unveiled at AUSA in October 2016. The MX-8 is capable of supporting up to four sensors simultaneously and has a clearance level of 28cm. Payload options include thermal, daylight colour and low-light imaging, continuous zoom IR and EO, LRF and laser illuminator. The sensors have real-time image enhancement, haze penetration, feature recognition and ID and automated video tracking. In addition, the system includes the MX-Series four-axis stabilisation with internal vibration isolation. The MX-GEO software suite automatically aligns to the aircraft, providing a target location capability. The US Army is understood to be carrying out tests of the MX-8 as part of its work developing a new tactical aerostat, and systems have been delivered for assessment. Power: 16-32V DC, 65W (avg), 180W (max) Diameter: 21cm MIL standard codes: MIL-STD-461E; MIL-STD-810F Interfaces: MX-Series C2, moving map, searchlight and radar; serial or Ethernet electrical interfaces Field of regard azimuth: continuous 360° Platforms: manned or unmanned airborne platforms Zoom - electronic: 2x, 4x FOV - narrow: 2.75° (TI); 1.53° (colour) Field of regard elevation: +30°/-120° Turret weight: 6.8kg FOV - wide: 28.9° (TI); 30° (colour) Thermal imager type and wavelength: 3-5µm, cooled Turret height:

26.2cm Daylight camera type: CMOS Resolution: 640x480 (TI); 1280x720 (colour) Features: built-in vibration isolation, built-in GPS receiver Laser rangefinder: Class I, eye-safe, diode-pumped Laser illuminator: Class IIIb, 852nm Laser illuminator - power: 150mW Video interfaces: HD-SDI video and NTSC or PAL Mounting: compatible with standard quick disconnect mounts

MX-10

The MX-10 is a multi-sensor, multispectral imaging system suitable for low-altitude tactical surveillance and SAR missions requiring low-weight installation. Customers can specify up to six sensors – four-FOV TI, daylight continuous zoom TV, low-light continuous zoom TV, LRF, laser illuminator (narrow or wide). Features: active four-axis stabilisation, IMU-inside technology, MX-GEO software suite for tracking. Applications: tactical surveillance & SAR Length: 22.8cm (hand controller unit) Power: 28V DC, 10A max, 4A steady state Weight: 16.8kg (all sensors) Weight: 1kg (hand controller unit) Diameter: 26cm Stabilisation: four-axis Laser rangefinder: erbium glass (Class 1), eye-safe; 1.54µm Platforms: fixed-wing, rotary-wing, UAV, aerostat Laser rangefinder max range: 20km Display resolution: 720p or 1080p HD video Certifications/MIL Standards: MIL-STD-704F; MIL-STD-461E, MIL-STD-810F Data interfaces: MIL-STD-1553B, ARINC 429, RS-232/422, Ethernet Communication interfaces: MX-Hand Controller IR/TI Camera resolution: 640x512 IR/TI Camera resolution: 3-5µm staring array Options: moving map, remote control, searchlight, radar, microwave/data link Components: up to 6 sensors, 4-FOV TI, daylight continuous zoom TV, low-light continuous zoom TV, LRF, laser illuminator (narrow or wide) Day channel: 5MP colour HD daylight camera Video interfaces: SMPTE 292M, NTSC/PAL Zoom - electronic: 2x, 4x Turret height: 35.5cm

MX-10D

The MX-10D is a multi-sensor, multispectral targeting system in a single-LRU configuration. It is designed to be mounted on fixed- and rotary-wing aircraft, UAVs and aerostats for low-altitude tactical surveillance and target designation. The <38cm (15in) turret supports up to six sensors simultaneously, such as IR, colour HD and electron-multiplied CCD imaging. The MX-10D features real-time image enhancement with high performance haze penetration, feature recognition and ID, and automated video tracking. The four-axis stabilised system has an internal IMU and MX-GEO software suite for accurate target location, which automatically aligns to the aircraft. The latest enhancements to the system are picture-in-picture capability and IR continuous zoom, added in 2015. The MX-10D includes the common operator interfaces and HCUs of the MX-series for simplified interchangeability. Installation flexibility is also provided by side-mounted connectors and compatibility with standard quick disconnect mounts. Built-in vibration isolation protects the internal payload components. Applications: ISR and targeting acquisition and designation Width: 269mm Height: 373mm Power: 112W steady state Stabilisation: four-axis Zoom - electronic: 2x, 4x Laser rangefinder max range: 20km Components: up to six sensors Thermal imager type: 640x512 3-5µm, 30.0° to 1.8° FOV, continuous zoom Turret dimensions: 27cm (Dia) x 37.4cm (H) Video interfaces: 720p or 1080p HD video; SMPTE HD digital and NTSC/PAL analog Laser target illuminator: Class 3b, NVG compatible, 852nm Laser rangefinder: Class I (eye-safe) 1.54µm Laser designator: 1064nm, compatible with US and NATO laser guided munitions Data interfaces: All standard MX-Series command and control, moving map, searchlight & radar interfaces; MIL-STD-1553B, ARINC 429, RS-232/422, Ethernet Certifications/MIL Standards: MIL-STD-461E, MIL-STD-810F Turret coverage in elevation: +90°/-120° Operating platforms: fixed- and rotary-wing aircraft, UAVs and aerostats Day channel: daylight 5MP colour HD, 36.3° to 1.0° FOV; low light 640x480 electron-multiplied CCD, 40.8° to 2.38° FOV Turret weight: 19.5kg Turret coverage in azimuth: continuous 360°

MX-15

The MX-15 is an HD multi-sensor, multispectral imaging system suitable for medium-altitude, covert ISR, armed reconnaissance and SAR missions. Up to six sensors can be supported simultaneously: four-FOV TI, daylight continuous zoom TV (one or three CCD offerings available), daylight spotter TV (with dual-channel spotter lens option), low-light spotter TV, LRF and laser illuminator. The MX-15 includes real-time image enhancement with haze penetration, feature recognition and image blending. The four-axis stabilised system has an internal IMU and MX-GEO software suite for accurate target location, which automatically aligns to the aircraft. Product enhancements include colour low-light zoom, SWIR, and step-zoom spotters. The MX-15 includes the common operator interfaces and HCUs of the MX-series for simplified interchangeability. On 19 July 2017, L3 Wescam announced that it had received an order from Airbus Helicopters to provide 37 MX-15 systems for installation on H225M Caracal helicopters (see separate entry) for two military customers. Applications: ISR, SAR Power: 280W steady state Diameter: 39cm Laser target illuminator: Diode, ANSI Class 4, 860nm Interfaces: All standard MX-Series command and control, moving map, searchlight & radar interfaces Certifications/MIL Standards: MIL-STD-461, MIL-STD-810 Day channel: 2MP colour low-light HD, continuous zoom, 1080p or 720p; 2MP colour daylight HD step-zoom spotter, 1080p or 720p Zoom - electronic: up to 4x Components: up to six sensors Slewing rates: 60°/s Laser rangefinder: Class I (eye-safe) 1.54µm Turret height: 48cm Thermal imager type: 640x512 InSb cooled MW starring array, 26.7° to 0.54° FOV; or 1280x1024 InSb cooled MW starring array, 35.5° to 1.2° FOV Data interfaces: MIL-STD-1553B, ARINC 429, RS-232/422, Ethernet Payload weight: 45kg Sensor configurations: low-light electron multiplied CCD spotter; or SWIR InGaAs spotter (options used with step-zoom spotter) Laser rangefinder max range: 20km Operating platforms: fixed- and rotary-wing aircraft, UAVs, aerostat Laser rangefinder accuracy: +/-5m

MX-15D

The MX-15D is a multi-sensor, multispectral targeting system. Suitable for medium-altitude, covert ISR, armed reconnaissance, CSAR and target designation. Up to ten sensors can be fitted: four-FOV TI, daylight continuous zoom TV, low-light continuous zoom TV, laser designator/rangefinder, laser illuminator, daylight spotter TV with triple-channel spotter lens, low-light spotter TV, SWIR spotter TV, laser spot tracker. Features include: ten-sensor payload capability; weight-optimised, interface flexibility, <5µrad stabilisation, digital cameras, IMU Inside technology, MX-GEO Gen III software suite for tracking. Applications: medium-altitude, covert ISR, armed reconnaissance, CSAR and target designation

The MX-20 long-range multi-sensor imaging system is suitable for high-altitude MPA and is mounted on the USMC AH-1Z helicopter, pictured here. (Photo: L3 Wescam)

Power: 430W steady state Diameter: 42cm Sensors: up to 10 Field of regard elevation: +90°/-120° Field of regard azimuth: continuous 360° Laser pointer/illuminator - wavelength: 860nm Laser rangefinder max range: 20km Slewing rates: 60°/s Laser rangefinder - type: diode-pumped – Nd:YAG/OPO, Class 4, 1064nm/1570nm selectable, compatible with US and NATO laser-guided munitions Payload weight: 51kg Laser pointer/illuminator - class/type: diode, Class 4; 1064nm laser spot tracker IR/TI Camera resolution: 640x512 3-5µm staring array, 26.7-0.54° FOV; or 1280x1024 3-5µm staring array HD IR, 35.5-1.2° FOV Turret height: 49.5cm Sensor configurations: 2MP colour HD daylight spotter TV with triple channel spotter lens; 640x480 low-light electron-multiplied CCD spotter TV, 0.37° FOV; SWIR spotter TV Certifications/MIL Standards: MIL-STD-461, MIL-STD-810 Operating platforms: fixed- and rotary-wing aircraft, UAVs Day channel: 5MP colour HD continuous zoom daylight TV, 720p or 1080p; low-light continuous zoom electron-multiplied CCD TV, 40.8° to 2.38° FOV Video interfaces: SMPTE HD digital and NTSC/PAL analogue; 720p or 1080p HD Data interfaces: all standard MX-series C2, moving map, searchlight and radar interfaces; MIL-STD-1553B, ARINC 429, RS-232/422, Ethernet

MX-20

The MX-20 is a long-range multi-sensor, multispectral imaging system, suitable for high-altitude, long-range MPA and persistent surveillance. It supports up to seven sensors, such as a TI, daylight continuous zoom TV (two 2MP colour HD sensor types available), daylight spotter TV (with dual-channel spotter lens option), low-light spotter TV, LRF and laser illuminator. Enhanced local area processing enables real-time image enhancement for EO day/night and IR, for increased stand-off range, feature detection/recognition and haze penetration. The five-axis stabilised system features the MX-GEO Gen III software suite and an embedded IMU which auto-aligns to the aircraft, providing target location accuracy. The MX-20 includes the common operator interfaces and LRUs of the MX-series, offering simplified interchangeability. Applications: ISR and targeting Power: 320W (avg); 1000W (max) Stabilisation: five-axis Laser rangefinder: Erbium glass, Class I (eye-safe), 1540nm Day channel: 2MP daylight continuous zoom colour HD, 1080p or 720p Data interfaces: All standard MX-Series command and control, moving map, searchlight & radar interfaces; MIL-STD-1553B, ARINC 429, RS-232/422, Ethernet IR Sensor Type: 640x512 3-5µm staring array TI, 720p or 1080p; 1280x1024 3-5µm staring array HD IR, 720p or 1080p Laser rangefinder max range: 30km Sensor configurations: 2MP colour HD or mono HD daylight spotter, 720p or 1080p; low-light charge-multiplying CCD spotter, 450-1,000nm selectable, 720p or 1080p Laser target illuminator: Diode, Class 4, 860nm Certifications/MIL Standards: MIL-STD-461, MIL-STD-810 Operating platforms: fixed- and rotary-wing aircraft, UAVs, aerostat Components: up to 7 sensors Laser rangefinder accuracy: +/-5m

MX-20D

The MX-20D is a long-range multi-sensor, multispectral imaging system, suitable for high-altitude, covert intelligence, SAR, armed reconnaissance CSAR and target designation. It supports up to six sensors, including those of the MX-20 (see separate entry): TI, daylight continuous zoom TV (two 2MP colour HD sensor types available), daylight spotter TV (with dual-channel spotter lens option), low-light spotter TV, LRF and laser illuminator. Additionally, the MX-20D offers a laser target designator

and laser spot tracker, compatible with US and NATO laser guided munitions. Enhanced local area processing enables real-time image enhancement for EO day/night and IR, for increased stand-off range, feature detection/recognition and haze penetration. The five-axis stabilised system has the MX-CEO Gen III software suite and an embedded IMU which auto-aligns to the aircraft, providing target location accuracy. The MX-20D includes the common operator interfaces and LRUs of the MX-series, offering simplified interchangeability, says the company. On 20 June 2017, L3 Technologies announced that the company has delivered its 4,000th MX-Series EO/IR imaging turret since the initial launch of the product line in 1997. The milestone delivery of L3's MX-20D to an undisclosed government customer was to aid close air support missions from long-endurance fixed-wing aircraft. Applications: high-altitude, long-range and persistent surveillance, covert ISR, armed reconnaissance, CSAR and target designation Length: 42.4cm (dia) Width: 19.1cm Height: 30.8cm Power: 320W (avg); 1,000W (max) Weight: 9kg Stabilisation: 5-axis gimbal with internal IMU Turret weight: <95.3kg (all sensors) MIL standard codes: MIL-STD-461, MIL-STD-810 Laser designator: Diode-pumped Nd:Yag, Class 4, 1064nm/1570nm selectable; 1064nm laser spot tracker Daylight camera type: 2MP daylight continuous zoom colour HD, 1080p or 720p IR sensor type and wavelength: 1280x1024 3-5µm staring array HD IR, 720p or 1080p Laser rangefinder accuracy: +/-2m Thermal imager type and wavelength: 640x512 3-5µm staring array TI, 720p or 1080p Components: up to 6 sensors Laser rangefinder max range: 20km Options: 3 laser illuminator divergence options Turret dimensions: 53.3 (dia) x 66.7cm (H) Data interfaces: All standard MX-Series C2, moving map, searchlight & radar interfaces; MIL-STD-1553B, ARINC 429, RS-232/422, Ethernet Sensor configurations: 2MP colour HD or mono HD daylight spotter, 720p or 1080p; low-light charge-multiplying CCD spotter, 450-1,000nm selectable, 720p or 1080p; SWIR spotter Laser illuminator - power: Diode, Class 4, 860nm

LEONARDO DRS

Arrowhead M-TADS/PNVS IR Receivers

DRS provides the integrated FLIR receivers for the Modernized Target Acquisition Designation Sight (M-TADS) and the Modernized Pilot Night Vision Sensor (M-PNVS) for Lockheed Martin's Arrowhead – the AH-64 Apache's EO fire control system, which is used for target acquisition/designation and safe flight in day, night and adverse weather conditions. Applications: target acquisition/designation and safe flight in day, night and adverse weather conditions Operating platforms: AH-64 Apache

MMS

The Mast Mounted Sight (MMS) is an integrated multi-sensor EO sighting system offering visible and IR capability. The MMS is equipped with a TI sensor, a high-resolution TV camera and an LRF/designator, along with a system processor, power supply, protective shrouds and other components. The TI camera enables pilots and crews to acquire, identify and target potential threats at distance by day or night. Mounted above a helicopter's rotor, the MMS promotes stealth and extended stand-off ranges, allowing craft to hide behind existing terrain while maintaining 360° surveillance. The MMS is in service on US Army OH-58Ds. Applications: surveillance in day, night and adverse weather conditions Laser designator: precise target designation for laser-guided weapons Operating platforms: OH-58D Kiowa Warriors Components: TV camera, thermal imagers, laser rangefinder/designator Mounts: mounted above the rotor

LEONARDO LAND & NAVAL DEFENCE ELECTRONICS

EOST-46

The EOST-46 is a multi-sensor turret system based on a modular payload, containing up to four sensors. It uses the proprietary ERICA Plus thermal imager, operating in the medium wavelength spectrum (3-5µm), based on the Leonardo FPA Hawk detector. For day operations, including low-light conditions, EOST-46 uses a 20x zoom TV colour and B&W; camera for target acquisition. A colour and B&W; high-magnification, long-range TV camera spotter is available for target identification at longer distances. As an alternative, a laser rangefinder can be installed. An NVG-compatible laser illuminator is also available which, in cooperation with TVCC or TV spotter, provides low-light search capability. Applications: ISR, targeting, SAR, coast guard, ALE, maritime patrol Height: 54cm Power: 150W (typical); 400W (max) at 28V DC Diameter: 35cm Stabilisation: 4-axis gyro-stabilisation Data interfaces: Serial link RS422, RS232, ARINC 429, 1553 optional IR sensor: Erica Plus thermal imager, operating in the medium wavelength spectrum IR sensor type and wavelength: 3-5µm; 640x512 array format Thermal imager type: medium wavelength spectrum, 3-5µm Zoom - optical: 20x Turret weight: 29kg Laser rangefinder: optional Field of regard azimuth: 360° continuous Electronic zoom: 12x Components: thermal imager, TV colour and B&W camera, camera spotter, laser illuminator Video interfaces: 3x ITU472-3 (PAL), XGA optional Platforms: fixed-wing aircraft, helicopters, UAVs Field of regard elevation: +40°/-120° Daylight camera type: colour CCD 1/4in size progressive scan

Titan 385ES-HD

The Titan 385ES-HD is an airborne multi-sensor turret system which is designed to offer high-resolution night vision capability in the medium-wave IR wavebands. A number of EO/IR configurations are available dependent on the operational application. The MWIR camera is supplemented as standard with an uncooled LWIR camera for instant availability, as well as a solid-state low-light-level TV camera. Optional sensor configurations include an eye-safe laser rangefinder, colour/low light monochrome spotter scope and laser illuminator/pointer. The Titan 385ES-HD incorporates an embedded video auto-tracker capable of operating on any of the imaging sensor channels. Graphics processing and aircraft interfaces are integrated into the single LRU design. Applications: ISR IR Sensor Type: HD SLX Merlin MWIR camera Operating platforms: CH-47

LOCKHEED MARTIN MISSILES AND FIRE CONTROL

Cyrocam 15DHD

Cyrocam 15DHD is a 38cm (15in) dual system that delivers HD and mid-wave thermal optics in a modular payload that supports ISR missions. The 15DHD features four-axis active stabilization and high image quality while moving. Other features include 56:1 continuous optical

zoom for colour camera. 30:1 continuous optical zoom for thermal camera, matched FOV, autofocus, autotrack, modular design for two-level maintenance, and IR colour pallets for improved situation awareness. Mission applications include mobile reconnaissance, C-IED/EOD, key infrastructure security, border/coastal surveillance, SAR (both airborne and maritime), and persistent ISR. Optional extras include a laser point/illuminator and eye-safe laser range finder, 6.5km class (standard), or 20km class. Applications: ISR, SAR Operating platforms: helicopters, UAVs Zoom - optical: 56:1 for colour camera, 30:1 for IR camera Laser rangefinder: optional Laser pointer: optional

Gyrocam 15DS

The Gyrocam 15DS 38cm (15in) Dual Sensor (DS) integrates an MW-cooled thermal imager and high-resolution, three-chip CCD colour camera into a gyro-stabilised system. Along with day/night mission capability, the DS offers 360°, 20:1 continuous zoom functionality and four-axis gyro-stabilisation for high image clarity and a stable platform to satisfy all mission requirements, according to the company. The Gyrocam 15DS rapidly interfaces with other sensor systems, including remote weapons, moving maps and DVR. Options include remote viewing capabilities, geolocation, auto-tracking and scene lock. Applications: day/night mission capability Stabilisation: 4-axis gyro-stabilisation MIL standard codes: MIL-STD-704D; MIL-STD-810F Thermal imager type and wavelength: 640x512; 3-5µm, mid-wave cooled Laser rangefinder max range: 2.5km, 6.5km or 20km Daylight camera type: 3-chip colour camera CCD-TV Laser pointer: Class IIIb; 830nM Options: remote viewing capabilities; geolocation; auto-tracking; scene lock; available colours include black, grey, tan or white Field of regard azimuth: 360° continuous Laser rangefinder accuracy: +/-5m Field of regard elevation: +/-85° Laser rangefinder: 1,550nM or 1,535nM (Class 1; eye-safe)

Gyrocam 15HDIR

The 38cm (15in) Gyrocam 15HDIR (High Definition IR) sensor is designed as a multi-mission surveillance system that allows law enforcement and military personnel to perform long-distance aerial surveillance by integrating a high-resolution, HD, three-chip colour CCD camera and continuous zoom, mid-wave cooled TI capabilities. This four-axis, gyro-stabilised hybrid system produces a straight HD signal and an NTSC system signal. The Gyrocam 15HDIR can convert an HDTV signal to NTSC or PAL. Using an RS232/422 interface, the Gyrocam 15HDIR integrates with other sensor systems, remote weapons, DVR, moving maps, user GUIs, radar and navigational units. It also has land and maritime applications. Applications: ISR Stabilisation: 4-axis, gyro-stabilised Day channel: high-resolution, HD, 3-chip colour CCD camera Thermal imager type: continuous zoom, mid-wave cooled thermal imaging Data interfaces: RS232/RS422 Components: camera, thermal imager

Gyrocam 15TS

The 38cm (15in) Gyrocam 15TS (Triple Sensor) integrates four-axis gyro-stabilisation, advanced mid-wave cooled thermal imaging, a three-chip colour CCD camera and next-generation NV capabilities into one system. This configuration incorporates an auto-gated night vision camera: Gen IV intensifier (2000ma/lumen sensitivity). Options include remote viewing capabilities, geolocation, auto-tracking and scene lock. With more than 1,100 systems deployed internationally and with the US military in various operations, the Gyrocam 15TS has a proven track record in demanding environments, in bright light, low-light or no-light conditions. Applications: ISR and targeting Laser rangefinder max range: 2.5km, 6.5km or 20km Day channel: 3-chip colour camera CCD-TV Certifications/MIL Standards: MIL-STD-704D; MIL-STD-810F Laser pointer: Class IIIb; 830nM Field of regard azimuth: 360° continuous Thermal imager type: 640x512; 3-5µm, mid-wave cooled Laser rangefinder accuracy: +/-5m Field of regard elevation: +/-85° Laser rangefinder: 1,550nM or 1,535nM (Class 1; eye-safe)

Gyrocam 9 Series

The Gyrocam 9 Series provides all the functionality of a larger unit in one third the volume and at half the weight, according to the company. The Gyrocam 9 Series is available in mid-wave cooled (9M) or long-wave uncooled (9L) thermal imaging configurations. Optional capabilities include HD colour, laser pointing, geolocation and an eye-safe laser rangefinder capable of ranging up to 20km from the observer. Rapid interfacing is readily available with other sensor systems, including remote weapons, moving maps and DVR. Stabilisation: 2-axis gyro-stabilisation Laser rangefinder max range: 45m to 2.5km; 50m to 6.5km; 50m to 20km Daylight camera type: CMOS colour (HD optional) Laser pointer: 852nM IR (optional); Class 3b (ANSI Z136.1-2000) Laser illuminator - power: 150mW Options: remote viewing capabilities; geolocation; auto-tracking; scene lock; colour options include black, grey, tan or white Field of regard azimuth: 360° continuous Laser rangefinder accuracy: +/-5m Field of regard elevation: +/-90° Laser rangefinder: 1,550nM or 1,535nM (Class 1; eye-safe) Thermal imager type and wavelength: 8-12µm, long-wave uncooled (9L); 3-5µm, mid-wave cooled (9M)

INFIRNO

INFIRNO is a targeting and ISR sensor system. It introduces a modular two-level maintenance, designed with nine LRUs. Customers are able to swap and reconfigure sensor payloads to meet specific mission requirements without moving the turret from the host platform. INFIRNO is applicable across ground, airborne and maritime platforms and includes high-definition sensors, advanced image processing and multi-target track capabilities proven in Lockheed Martin's Sniper ATP and Apache M-TADS/PNVS. Applications: ISR and targeting Operating platforms: airborne, ground and maritime

M-DSA

M-DSA is the next step in the sensor modernisation of the M-TADS/PNVS system. Upgraded capabilities support rapid target identification and coordination for Apache aircrews. M-DSA incorporates a laser rangefinder designator, inertial measuring unit (IMU) and extended-range algorithms to increase M-TADS/PNVS designation and ranging possibilities. The upgraded sensor enables Apache pilots to see high-resolution, HD, near-IR and colour imagery on cockpit displays. The M-DSA matched FOV allows image blending with the M-TADS FLIR and enables pilots to see civilian and military lighting on a single display more clearly. M-DSA also provides a new laser pointer marker that improves co-ordination with ground troops and an updated multi-mode laser with eye-safe lasing ability that supports flight in urban environments and home station training. According to the company, this modification to M-TADS/PNVS (see separate

entry) resolves obsolescence issues, ensures compatibility with future weapons and supports improvements in sustainability, reliability and maintainability enabling two-level maintenance. Applications: ISR and targeting Stabilisation: inertial measurement unit Components: day and night sensor assemblies, laser rangefinder/designator, TV sensor, laser spot tracker

M-TADS/PNVS

The Modernised Target Acquisition Designation Sight/Pilot Night Vision Sensor (M-TADS/PNVS) is the advanced EO fire control system that US Army AH-64 Apache helicopter pilots use for safe flight in day, night or bad weather missions. M-TADS/PNVS enhances system performance and reliability by more than 150%, reduces maintenance actions by nearly 60%, and will save the US Army nearly $1 billion in operation and support costs over its 40-year system life, states the company. M-TADS/PNVS modular architecture accommodates a field retrofit from TADS/PNVS to the new configuration on the AH-64E. More than 1,350 systems have been delivered to date. A performance-based logistics (PBL) contract was initiated in 2007 for TADS/PNVS and M-TADS/PNVS systems. The PBL contract provides complete post-production supply chain management, including spares planning, procurement, repairs, maintenance, modifications and inventory management of fielded systems. The Modernised Day Sensor Assembly (M-DSA) (see separate entry) updates the entire DSA system to enhance performance and address obsolescence, as well as increase the system's ability to fully accommodate weapons now in production. Applications: ISR and targeting Operating platforms: AH-64D/E Apache

TEDAC

The TADS Electronic Display and Control Assembly (TEDAC) presents the co-pilot/gunner (CPG) with high-resolution sensor video from the Modernized Target Acquisition and Designation Sight (M-TADS). The TEDAC is located in the CPG crew station of the AH-64D/E Apache helicopter and is the modernised replacement for the Optical Relay Tube. The TEDAC provides a 5x5in flat-panel cockpit display that utilises active matrix LCD technology. This high-resolution display improves the CPG's ability to engage targets while providing greater situational awareness and more survivable space in the cockpit, according to the company. Applications: targeting Operating platforms: AH-64 Apache

TSS

The Target Sight System (TSS) is the multi-sensor EO/IR fire control system (AN/AAQ-30) for the USMC AH-1Z attack helicopter. It has a large-aperture MW FLIR sensor, a colour TV, a laser designator/rangefinder (with eye-safe mode) and an on-gimbal IMU integrated into a 15µrad stabilised turret. The turret mounts on the nose of the aircraft via a Lockheed Martin-developed interface structure. The TSS provides the capability to identify and laser-designate targets at maximum weapon range. Applications: ISR and targeting Operating platforms: AH-1Z

RAYTHEON

CSP

The Common Sensor Payload (CSP) joins Raytheon's family of targeting systems that provide ISTAR mission capabilities to the warfighter. CSP will benefit from, and contribute to, synergies in common technology, capabilities and mission support. Raytheon claims its approach will deliver a common targeting sensor and provide: common capabilities, view/operation of sensors across platforms (FOV, characters etc); common sensor procurement to simplify acquisition and unit cost; common systems integration approach across platforms to simplify capabilities growth and reduce cost; commonality in mission support for reduction of sensor logistical footprint and fewer maintainers required. Raytheon will leverage its Common EO Factory core capability, based in McKinney, Texas, meaning that CSP will benefit from proven system design, development and production efficiencies. Applications: ISR and targeting

RAYTHEON SPACE & AIRBORNE SYSTEMS

AN/AAQ-27A

In production for USMC MV-22 Osprey tiltrotors, the AAQ-27 is a mid-wave IR system that has much in common with the AAQ-16B. Options: e-zoom, dual-mode tracker. IR Sensor Type: 3-5µm, InSb, 480x640px, staring array detector with two FOVs (30x40° and 5x6.7°) Payload weight: <40.82kg Operating platforms: MV-22 Osprey Turret dimensions: 36.04x30.53cm Turret weight: 22.67kg

AN/AAQ-29A

In production for the USMC CH-53E and USAF HH-60G, the MWIR AAQ-29A is similar to the AN/AAQ-27A, except that it incorporates an additional third FOV (1.3x1.73°). Options: e-zoom, dual-mode tracker. IR Sensor Type: 3-5µm, InSb, 480x640px, staring array detector with two FoVs (30x40° and 5x6.7°) Payload weight: <40.82kg Operating platforms: CH-53E, HH-60G Turret dimensions: 36.04x30.53cm Turret weight: 22.67kg

AN/AAS-44(V)

The AN/AAS-44(V) is a multipurpose thermal imaging sensor that provides long-range surveillance, target acquisition, tracking, rangefinding and laser designation for Hellfire and all tri-service/NATO laser-guided munitions. Includes: six-axis high-performance stabilisation, real-time image processing/contrast enhancement, adaptable interface, dual-mode video tracker, laser rangefinder/designator, programmable symbology generators, embedded maintenance features. There is an automatic video tracker dual-mode (centroid/area). Applications: ISR and targeting Power: 0.9kVA, 115V AC, three-phase, 400Hz, 200W, 28V DC Gimbal angular coverage: azimuth 360° continuous; elevation +60/-105° FOV - Electronic: 2:1 (0.63x0.84°), 4:1 (0.32x0.42°) FOV - narrow: 1.26x1.68° Max air speed: >300kt Slewing rates: 3rad/s FOV - Optical: 5x6.67° FOV - wide: 22.5x30° Data interfaces: 1553B data bus and/or discrete control; video outputs – RS170 (525 line), digital; other formats available

AN/AAS-52

The AN/AAS-52 is a multispectral EO/IR turreted system that provides long-range surveillance, target acquisition, tracking, rangefinding and laser designation for Hellfire and all tri-service/NATO laser-guided munitions. AAS-52 is in production for the USAF Predator UAV and has been selected by the US Army for the Extended-Range Multipurpose UAV. Includes: six-axis high-performance stabilisation, real-time image processing/contrast enhancement, adaptable interface, dual-mode video tracker, laser rangefinder/designator, programmable

symbology generators, embedded maintenance features, automatic video tracker dual-mode (centroid/area). Applications: ISR and targeting Power: 0.9kVA, 115V AC, three-phase, 400Hz, 200W, 28V DC FOV - narrow: narrow 1.2x1.6°, ultra-narrow 0.6x0.8° Slewing rates: 3rad/s Max air speed: >300kt FOV - Optical: 5.7x7.6° FOV - wide: wide 33x44°, medium/wide 15x20° Data interfaces: 1553B data bus and/or discrete control; video outputs – RS170 (525-line), digital; other formats available Gimbal angular coverage: azimuth 360° continuous; elevation +60/-105°

AN/ZSQ-2

The ZSQ-2 is an EO/IR turreted system that contains three imaging sensors: an IR camera with 3-5µm, InSb, 480x640px, staring array detector; an image-intensified TV; and a day colour TV. The sensors are coaxially mounted on a four-FOV telescope. The 'Assault' version of the ZSQ-2 has a laser pointer and eye-safe LRF. The 'Attack' variant has a laser pointer, laser spot tracker and laser designator/rangefinder. The ZSQ-2 is in production for US Army special operations AH-6 Little Birds, MH-60 Black Hawks and CH-47 Chinooks. Applications: ISR and targeting Day channel: day colour TV IR Sensor Type: 3-5µm, InSb, 480x640px, staring array detector; an image-intensified TV Laser designator: available on Attack version Operating platforms: AH-6, UH-60 and CH-47 Laser rangefinder: available on Assault and Attack versions Laser pointer: available on Assault and Attack versions

SAAB

Helios/HeliTOW

A stabilised direct view optical system for surveillance and targeting, HeliTOW includes TOW missile tracking and guidance systems. The sight unit provides the gunner with a high-resolution image day and night, enabling detection, identification and tracking of targets at long range. Large FOV and high resolution give a high target-detection probability in short search times. Transmission: greater than 27%. Dioptre settings: -5.25/+4. LoS deflection: +/-25° in elevation, +/-120° in azimuth. Status: more than 200 systems have been delivered and are in service with the Swedish Army, Royal Danish Army, Italian Army, Belgian Army, Republic of Singapore Air Force and Nigerian Air Force. Applications: ISR and targeting Stabilisation: LoS jitter <15µrad RMS FOV - Optical: 20° and 5° Operating platforms: six helicopter types, including AW109 and AW129, Bell 406CS, AS550 and Bö 105 Zoom - optical: 3 and 12x

SEOS

The Stabilised EO System (SEOS) is designed for surveillance and targeting. It has been developed using experience from Helios and HeliTOW programmes. Basic system: thermal imager, TV cameras, laser rangefinder. Options: laser designator, missile tracker/beam rider unit, low-light-level TV camera, 3-5µm thermal imager. Image processing: automatic target detection and tracking, image freeze/store, area tracking, thermal cueing, electronic magnification, image integration, graphics generation and overlay. Built-in test: power-up test, function monitoring, integrated BIT. Applications: ISR and targeting Width: Sensor head – 0.5m Height: Sensor head – 0.7m Stabilisation: LoS jitter under 15µrad RMS Field of regard elevation: +85°/-30 FOV - wide: 18° Data interfaces: 1553B, RS422, others available Field of regard azimuth: +/-200° azimuth with an option for nx360° Max traverse rate: 100°/s FOV - narrow: 1.5° FOV - Optical: 6° Thermal imager type: 8-12µm (optional 3-5µm)

SAFRAN ELECTRONICS & DEFENSE

Euroflir 350

The Euroflir 350 is a gyro-stabilised optronic payload within a turret. It is effective at long ranges and can track mobile targets, designate important areas for the pilot, generate an automatic terrain scanning for SAR missions and provide information on sighted targets, according to the company. The system comprises TI and HD TV colour cameras, both with continuous optical zoom, an LRF and a laser pointer. The Euroflir 350 is used for military and security missions: air-land, intelligence, maritime patrol, border and coastal surveillance, SAR/CSAR, special forces and naval operations. It can also be used on light helicopters for law enforcement missions. Applications: ISR and targeting for helicopters, UAVs Width: 356mm (dia) Stabilisation: 4-axis gyro-stabilisation Laser rangefinder: eye-safe 1.57µm Zoom - optical: 18x continuous Gimbal angular coverage - azimuth: nx360° Interfaces: video tracker/geo-tracker, geo-pointing/geo-location, video control and image processing Laser rangefinder max range: 20km IR/TI Camera resolution: 680x512px Laser pointer: eye-safe Class IIIb, 830nm Operating platforms: French Army Cougar and EC725 Caracal helicopters, Sperwer Mk II tactical UAVs IR/TI Camera spectrum: 3-5µm Turret weight: <32kg Day channel: HD TV colour camera FOV - ultra narrow: down to 0.16° Recognition range: 6.5km (man); 9.5km (vehicle) FOV - medium: 1.3-24° Identification range: 3km (man); 5.5km (vehicle) Gimbal angular coverage - elevation: +35/-120°

Euroflir 410

Unveiled at the Paris Air Show 2017, the modular Euroflir 410 gyro-stabilised optronic payload is designed for a variety of military and security air vehicles to provide all-weather long-range observation and precision targeting for air-to-ground munitions. It can incorporate a variety of sensors: HD TV colour camera, multi-channel spotter with SWIR sensor, low-light level TV, laser designator, laser pointer, optional laser illuminator, TI and LRF. The Euroflir 410 features standard interfaces, enabling it to be integrated with other mission systems and to communicate with onboard systems directly from the cockpit or a control station. The data streams convey tactical situations, enable multi-sensor deployment and support combat systems. Safran offers air vehicle certification and modifications, user training for operations and maintenance, and a through-life support package. The Euroflir 410 will be an integral part of the imaging system on the French Army's Sagem Patroller UAV; in April 2016, the army ordered two systems each consisting of five UAVs plus four for training. Applications: ISR/targeting for fixed-wing aircraft, helicopters, UAVs Width: 410mm (dia) Stabilisation: 4-axis gyro-stabilisation Zoom - optical: 18x continuous Turret weight: <45kg Identification range: 3km (man); 5.5km (vehicle) FOV - medium: 1.3-24° FOV - ultra narrow: down to 0.16° Recognition range: 6.5km (man); 9.5km (vehicle) Laser pointer: eye-safe Class IIIb, 830nm Zoom - electronic: 2x, 4x (spotter) Gimbal angular coverage - azimuth: nx360° Gimbal angular coverage - elevation: +35/-120° Operating platforms: Patroller UAV Interfaces: video tracker/geo tracker, geo-pointing/geo-location, video control and image processing Daylight channel: 1,920x1,080px HD TV

colour Laser rangefinder: eye-safe 1.57µm IR/TI Camera spectrum: 3-5µm

Euroflir 410 SP

The Euroflir 410 SP optronic payload incorporates up to seven sensors to enable fixed-wing aircraft, helicopters and UAVs to conduct ISR and precision targeting missions. Applications: ISR and targeting for fixed-wing aircraft, helicopters and UAVs Width: 406mm (dia) Stabilisation: 4-axis gyro-stabilisation Zoom - electronic: 2x, 4x (spotter) Interfaces: video tracker/geo tracker, geo-pointing/geo-location, video control and image processing Operating platforms: Patroller UAV Laser rangefinder: eye-safe 1.57µm Laser rangefinder - range: 100m-20km Turret weight: <45kg Daylight channel: 1,920x1,080px HD TV colour IR/TI Camera spectrum: 3-5µm Laser pointer: eye-safe Class IIIb, 830nm FOV - medium: 1.3-24° Gimbal angular coverage - azimuth: nx360° FOV - ultra narrow: down to 0.16° Gimbal angular coverage - elevation: +20/-120°

Odin

Based on the around-the-corner sighting product developed for the French Army's FELIN digital soldier systems, Odin provides personnel in combat with a protective firing capability. The system is designed to allow Odin-equipped machine gunners to provide highly effective fire without exposing themselves or forcing the aircraft to carry out specific manoeuvres. Odin also provides collective weapons with firing accuracy, thus optimising ammunition management. Highly tactical, Odin draws on the FELIN programme's IR technology: the day and thermal channels are integrated in a single housing. It is rapidly activated and makes little noise. It is modular, weighs 1.3kg and can identify a vehicle in combat from up to 620m away in IR mode and from 2,150m in day mode. The system was tested in 2009 with a .50cal heavy machine gun and a 20mm cannon. Operating temperature: +55°C/-32°C

Olosp

The Olosp is a steerable, IR and visible dual-sensor platform designed for airborne surveillance. It comprises an electronic control unit and a hand controller or laptop. Main features: steerable, hardened, watertight, four-axis stabilised turret. Azimuth coverage: 360°. Elevation coverage: +20/-120°. Can be offered in two versions: Iris and Matis. Iris: 8-12µm camera, based on IRCMOS technology, 288x4 elements, with multiple FOVs: narrow 4x3°; wide 18x13.5°; magnification 1.6 and 7.5x. Matis: 3-5µm camera based on InSb technology, 768x512 elements (with microscan); or MCT (HgCdTe) technology, 640x480 elements (with microscan); narrow FOV 1.3x0.9°; wide FOV 26x18°, continuous zoom 20x. Olosp is fully qualified in flight conditions and integrates an automated target-tracking capability. It integrates with TV sensors, 3-CCD colour cameras or high-resolution B&W; sensors. Applications: ISR Width: 350 or 410mm, according to requirements Height: 500mm Power: 18-32V DC, <15A Stabilisation: <5µrad RMS Certifications/ MIL Standards: MIL-STD-810E, compatible with naval environment Turret weight: <30kg Operating platforms: NH90 naval version Interfaces: video output IR - RS170 or CCIR; video output visible - RS170 or CCIR/PAL Data interfaces: MIL-STD-1553, 1760 bus interface, real-time image transmission to ground station

Osiris

Osiris is a mast-mounted, gyro-stabilised sight for Tiger antitank helicopters, part of the long-range TRIGAT anti-armour missile system. It is used for terrain observation, target acquisition and fire control. TI: Iris 8-12µm, Gen II; FOV 40x30°, 8x3.5°, 4.7x3.5°, 1.5x1.1° and 0.75x0.56°. TV camera: CCD, visible, NIR bands; FOV 8x6°, 2.5x1.9° and 0.75x0.56°. LRF: eye-safe. Localiser: IR goniometer for HOT missiles. Up to four targets (selected by gunner) engaged at once, tracking them automatically and handing each off to a TRIGAT seeker. Applications: ISR and targeting Mounts: mast-mounted Day channel: TV camera - CCD, visible, near-IR bands FOV - Optical: telescope - varies the FoV from 30x40° down to <1°; TV camera: three FoV 8x6°, 2.5x1.98° and 0.75x0.56° Thermal imager type: 8-12µm Condor 1 Iris second-generation based on a 6x288 element array of IRCMOS technology Operating platforms: UHT Tigers Laser rangefinder: 1.54µm eye-safe Components: gyro-stabilised sight head, thermal imager, TV camera, laser rangefinder

Strix/Nightowl

Strix/Nightowl is a roof- or nose-mounted reconnaissance and weapon aiming sight for helicopters. Strix is designed for terrain observation, target acquisition (detection, recognition, identification and localisation) and aiming guns, rockets, air-to-air missiles, laser-guided weapons and fire-and-forget missiles. Nightowl has antitank capabilities, including designation for laser-homing missiles. Both systems include eye-safe laser rangefinder or designator. Direct-view optics (Strix): WFOV 12°, NFOV 3.5°. Iris TI: longwave IR. Iris FoV: 39x30°, 6.2x4.6°, 2.1x1.6°, zoom 1.1x0.8°. Eye-safe LRF or rangefinder/designator. CCD TV camera: CCIR 625 lines. FoV: two or three depending on application. Applications: ISR and targeting Stabilisation: 2-axis and automatic inflight boresighting Field of regard elevation: +40°/-25° Day channel: CCD TV camera - CCIR 625 lines FOV - wide: (Strix): 12° Data interfaces: 1553B Field of regard azimuth: +/-120° azimuth FOV - Optical: Iris thermal imager - FOV: 39x30°, 6.2x4.6°, 2.1x1.6° FOV - narrow: (Strix): 3.5° Thermal imager type: Iris thermal imager - LWIR Operating platforms: all Tiger versions, Rooivalk Zoom - optical: 1.1x0.8°

The Euroflir range of EO gyro-stabilised observation systems are equipped with thermal cameras, HD day cameras and laser sensors, allowing them to carry out numerous rotary-wing military missions. (Photo: Safran Electronics & Defense)

Viviane

A gyro-stabilised night and adverse weather observation system and missile sight. Direct view optics: two selectable FOVs, 17° (3.3x) and 5° (11x). Missile localiser: HOT 3 anti-jamming goniometer. Applications: ISR and targeting Components: direct view optical sight, a thermal imager, a laser rangefinder and a localiser/goniometer for HOT missiles Field of regard azimuth: +/-120° Thermal imager type: 8-12µm camera; 4x selectable FOVs 39x30° (1.5x), 6.2x4.6° (7.5x), 2.1x1.6° (19x) and 1.1x0.8° Operating platforms: French Army Gazelles Laser rangefinder accuracy: accurate to +/-5m at 10km Field of regard elevation: +30°/-25° Laser rangefinder: 1.06µm

THALES OPTRONIQUE

AGILE

The Airborne Gyro-stabilised IR Light Equipment (AGILE) is a dual/tri/quad sensor system for day and night surveillance, observation, border and maritime patrol, law enforcement and SAR missions. It can be installed on fixed-wing aircraft, helicopters, UAVs and naval vessels. Sensors: high-resolution 3-5µm TI (8-12µm option), high-resolution colour CCD TV, eye-safe 1.54µm LRF, NIR laser pointer. Width: 300mm diameter Height: 450mm Weight: 17kg Stabilisation: 2 axes, 4 optional FOV - TV: from 50x38° to 2.2x1.6° with continuous zoom Platforms: fixed and rotary-wing aircraft, naval Laser pointer range: 8km Laser rangefinder - range: 15km FOV - IR: from 27x20° to 2.2x1.6° with continuous zoom

TRAKKA SYSTEMS USA

SWE-400 QUAD

The Trakka Systems TrakkaCam SWE-400 QUAD utility and environmental inspection camera combines all of the sensors and features found in the SWE-300 series, with the addition of a megapixel digital frame camera in a 400mm fully digital four-axis gyro-stabilised platform. The photo camera offers fast auto focusing and fast image storage for high-resolution fault reference capture. All stored photos are geo-referenced with location information. The SWE-400 QUAD offers commercial users the capability to measure temperatures in real time, to detect Corona discharges and to collect high-resolution video and digital still images from an airborne platform. The systems can be fully integrated with geo-spatial recorders, mapping systems and reporting software to deliver fault reports to industry users. According to the company, the products are ITAR-free and widely exportable. For stable, long range imaging, a fully digital 4-axis active gyro stabilisation system compensates for aircraft manoeuvring and eliminates external vibrations. The radiometric output provides full thermal resolution images for temperature analysis and reporting, while the solar blind camera detects UV discharges in the full daylight. The system has a 36.3MP photo camera providing high-resolution still images. The IMU/INS combined with the laser rangefinder provides geographical locations of points of interest. The tracker locks the camera to any structure or scene. Typical applications include: powerline asset inspection; right of way surveys; storm damage assessment; pipeline inspection; agriculture monitoring; environmental surveys; animal surveys; and forest fire-fighting and mapping. Power: 20-30VDC, 250W Weight: 31kg Coverage: 360° continuous Stabilisation: ≈15µRad Zoom - optical: 30x (60° to 2°)

TC-300

The TrakkaCam TC-300 surveillance camera is a multi-sensor surveillance system in a single-LRU configuration. The payload suite comprises six sensor channels, namely a MWIR thermal imager and colour HDTV – both with continuous zoom – an LRF, laser pointer and laser illuminator. The TC-300 includes an integrated IMU/GPS that provides geolocation and moving map integration. KLV metadata – via gigabyte Ethernet interfaces – to Trakka Systems' augmented reality moving map and video management system as well as to third-party mapping systems. On-screen graphics display aircraft and target position, range, heading, speed and altitude. The HD video engine includes automatic target tracking, scene hold, image blending and haze reduction. The EO/IR sensors process images to provide visibility in conditions of fog, haze, low light and complete darkness. The TC-300 is a non-ITAR exportable system. Applications: ALE, SAR, ISR on helicopter, fixed-wing and UAV platforms Width: 300mm (dia) Power: 85W (steady state), 26-36V Stabilisation: digital 4-axis gyro-stabilisation Field of regard elevation: +20/-120° Data interfaces: RS-232, RS-422 Electronic zoom: continuous FOV - narrow: 1.28° (TI); 0.86° (CCD) Resolution: 640x512, 720p (TI); 1,080p (CCD) Laser pointer: Class IIIb, 860nm, 470mW FOV - wide: 30° (TI); 32.6° (CCD) Daylight camera type: CCD HD Laser rangefinder max range: 20km Turret weight: <19kg Field of regard azimuth: continuous Laser rangefinder: 1,535nm, eye-safe Video interfaces: SMPTE HD, H.264 over Ethernet Thermal imager type and wavelength: MCT or InSb; 3-5µm MWIR

URALS OPTICAL AND MECHANICAL PLANT UOMZ

GOES 342

The GOES 342 is an observation and sighting system for the Ka-50 combat helicopter and its derivatives. Day and night acquisition and recognition of ground and surface targets; laser ranging/sighting of machine guns; guns and unguided missiles aircraft missile guidance. Applications: ISR and targeting Length: 613mm Width: 460mm Operating temperature: +/-50°C Components: FoV stabilisation system, TV channel, Module-Avia thermal imaging channel, laser rangefinder, direction finder Field of regard azimuth: +/-230° azimuth Payload weight: 90kg Operating platforms: Ka-50 Field of regard elevation: +25°/-115°

GOES 520

The GOES 520 is a day and night observation system for the Ka-50 combat helicopter and its derivatives. Applications: ISR Length: 500mm Width: 350mm Operating temperature: +/-50°C Components: low-level TV channel; thermal imaging channel Field of regard azimuth: +/-180° Payload weight: 45kg Operating platforms: Ka-50 Field of regard elevation: +35°/-85°

GOES-451M

The GOES 451M is a day and night observation and sighting system installed on the Mi-28NM for the Russian Army Aviation. The system is a follow-on from the GOES 451—a payload used on the Ka-52—with the same functionality.

RADARS

HARRIS ELECTRONIC SYSTEMS

Airborne CMMR

The Airborne Compact Multi Mode Radar (CMMR) is a small, lightweight, lower-price version of the mature X-band radar system originally designed by ELTA (EL/M-2022). Exelis and ELTA have teamed up to manufacture and provide technical and logistics support in the USA. CMMR is primarily intended for operation on helicopters and UAVs. The CMMR's receiver processor is in use worldwide as a component on several airborne radar products. Applications include military operations: periscope detection, fleet protection; intelligence operations: coastal surveillance and intelligence-gathering; homeland defence: law enforcement, anti-drug smuggling, illegal immigration, pollution spills, shipping control, ice patrol, SAR. Modes: GMTI – detection and display of moving targets on top of SAR image or on a geographical map; selective moving target indication – detection and display of moving targets on top of SAR image at sea; surface search – detects targets to 370km range in all sea states; spot SAR – high-resolution imaging of a ground area of interest; strip SAR – produces a continuous image up to 65km wide; inverse SAR – used to identify and classify ships by creating an image, corrected for aspect; ground target track – accurate tracking of stationary and moving targets of interest; circular SAR – used to create an image of ships in calm waters; range signature – displays target outline features during normal search; air-to-air – detection and tracking of aircraft to 800kt; nav/weather – real-beam mapping and four-colour weather plus turbulence. Platforms: UAVs and helicopters

IAI ELTA SYSTEMS

ELM-2022A

The ELM-2022A is a maritime surveillance radar family which can be used for long-range surveillance and ASW, navigation and weather, maritime moving-target indication, Doppler beam sharpening, SAR, ISAR and range profile classification and beacon interrogation. Specific tasks the radar system is design to perform include littoral warfare operations, maritime surveillance and patrols in exclusive economic zones, anti-drug enforcement operations, coast guard and fisheries patrol and location and search and rescue. Its modular hardware design, flexible avionics interfaces and antenna design enable easy installation in a variety of fixed- and rotary-wing aircraft. These include VANTs, helicopters, transport aircraft and business jets. The system features low false alarm rates, TWS of up to 100 targets, expand and freeze, sector/full scan, detection and track accuracies compatible with EO systems and ECCM with a low probability of intercept and low sidelobe levels. Its operational features include IFF interrogator compatibility, control interface to EO systems, integrated radar and optical sensor video display and different video interface standards. The ELM-2022A also has growth potential with spare memory space and computing power as well as different video interface standards. On 23 October 2017, it was announced that IAI has been contracted by Airbus Defence and Space for the ELM-2022A maritime patrol radar to equip the 16 C-295 maritime surveillance aircraft being purchased from Airbus by the Canadian government for SAR operations. Weight: 100kg MIL Standards: MIL-STD-1553B, RS422 Azimuth: 360° Power consumption: 115V

ELM-2055 SAR/GMTI

The ELM-2055 provides all weather, all visibility, air-to-surface ISTAR for manned and unmanned airborne platforms. Together with the ELS-8994 GES, the ELM-2055 can be used for applications such as ISTAR, protection of borders and strategic assets, anti-terror warfare, smuggling and counter-narcotics, cartography, forensic investigation and disaster-relief operations. Features include real-time SAR imagery for wide-area surveillance and high-resolution SAR spot for stationary target classification; GMTI capabilities including persistent surveillance over large areas and detection and tracking of a range of target types; standoff ranges of up to 60km, facilitating covert operations. Power: 800W Weight: 50-58kg Platforms: tactical and MALE UAS, light reconnaissance aircraft and tethered aerostats

LEONARDO AIRBORNE & SPACE SYSTEMS

Seaspray 5000E

The Seaspray 5000E multi-mode surveillance radar is the lightest member of the Seaspray AESA radar family and employs the same common processor, coupled with a compact AESA antenna covering air-to-surface/air-to-air environments. Seaspray 5000E radars are installed in fixed- and rotary- wing platforms, for manned and unmanned operations, and are in operational service globally. The radar's technology minimises the impact of transmitter failure by removing the single point failure, the high-power, relatively low-MTBF LRU. This is replaced by many T/R modules with high MTBFs within the antenna array. At the centre of the radar design is the ability to tolerate individual item failure. Component failures within the array result in gradual performance degradation rather than complete system failure. In 2015, the company (then known as Selex) was awarded a contract from Cobham Aviation Services in Australia for the supply of its Seaspray 5000E radars. Cobham will use the radars to equip CL-604 Challenger aircraft for search and rescue operations with the Australian Maritime Safety Authority. Applications: surface surveillance, navigation, beacon detection and target imaging/classification Weight: 48kg Detection range: 370km Operating platforms: manned/unmanned aircraft MTBF: ~2,000h

Seaspray 7000E

The Seaspray 7000E is an AESA radar for helicopters, fixed-wing aircraft and UAVs. It combines AESA with a COTS-based processor to deliver a range of surveillance capabilities covering air-to-surface, air-to-air and air-to-ground environments. The radar has ISAR, SAR, GMTI and other surveillance modes. Azimuth coverage uses a combination of electronic and mechanical scanning, while elevation scanning is all-electronic. The Seaspray 7000E features multiple low-power, solid-state T/R modules and the use of composite mechanical and electronic scanning enables performance in detecting small targets, such as fast inshore attack craft in high sea states. The UK RN was the launch customer, selecting the Seaspray 7000E for integration into the AW159. Applications: land, sea and air surveillance Scan rate: 360°

Weight: 86kg Range: 370km (590km weather mode) Operating platforms: UK AW159 and other helicopters, fixed-wing aircraft and UAVs MTBF: 2,000h Frequency coverage: X-band

LOCKHEED MARTIN MISSILES AND FIRE CONTROL

LONGBOW FCR (AN/APG-78)

The LONGBOW system is built by a JV of Lockheed Martin and Northrop Grumman. US Army testing shows integrated capabilities enhance the Apache lethality fourfold and survivability sevenfold. The mission equipment package is in production for the US and several international customers. The LONGBOW weapon system has been battle-proven in Operation Enduring Freedom and Operation Iraqi Freedom. It has been in full-rate production since 1996, with the first unit equipped in 1998. More than 400 radars and more than 14,000 missiles have been contracted for the US Army and international customers. For the AH-64E helicopter, a Radar Electronics Unit (REU) replaces two line-replaceable units. The REU provides growth capabilities to the LONGBOW Fire Control Radar (FCR) and will reduce maintenance costs. The LONGBOW FCR has a low probability of intercept. It rapidly and automatically searches, detects, locates, classifies and prioritises multiple moving and stationary targets on land, water and in the air in all weather and battlefield conditions from stand-off ranges. Target co-ordinates are automatically available to other sensors and weapons for target confirmation, rapid engagement and reduced fratricide. Target data is digitally available through the data modem for real-time transfer to other platforms and command posts. The self-contained radar frequency interferometer provides rapid and accurate identification of and azimuth to enemy air defence units. High system reliability and two-level maintenance maximises operational availability and reduces support costs, according to the company. In 2016, Lockheed Martin was awarded an $89.8 million contract by the US army to upgrade the Apache helicopter's LONGBOW FCR. The contract includes the manufacturing of 84 Radar Electronics Units and software upgrades. Applications: fire control Detection range: 8km Operating platforms: AH-64D/E

The LONGBOW Fire Control Radar is pictured here mounted atop the AH-64 Apache attack helicopter main rotor. (Photo: Lockheed Martin)

RAYTHEON SPACE & AIRBORNE SYSTEMS

AN Series

The AN Series of radars from Raytheon include Linear FM, fixed or agile ASW and ASuW radars derived from the AN/APS-137 which was installed on the P-3 aircraft. They are designed for the detection of periscopes exposed for under five seconds. The radar modes for the series include: periscope and small target, surface surveillance, navigation and weather alert. The image antenna is stabilised, with 360° scan; 6, 60 and 300rpm sector scans; and 34.5dB gain transmitter. The systems' detection ranges include periscope SS4 at 45km, large patrol boat, SS4 at 140km and a destroyer SS5 at 315km. The capabilities of the AN Series include classification while scanning, coherent look-down air target detection and tracking, DBS, GMTI, image classification and control and display. Standard interfaces include: 1553, ARINC 407 synchro, RS232, RS343 and RS170 video. Applications: ASW, ASuW Scan rate: antenna – stabilised, nx360° scan, 6, 60 and 300rpm sector scans, 34.5dB gain Detection range: periscope, SS4, 46.3km; large patrol boat, SS4, 140km; destroyer in SS5, 315km Power output: transmitter – coherent, 500kW peak, 500W average power Frequency coverage: 9.5-10GHz, linear FM, fixed or agile

AN/APQ-174/186 MMR

The AN/APQ-174/186 Multi-Mode Radar (MMR) family provides terrain following and terrain for a variety of military aircraft. The MMR allows safe flight down to a 100ft clearance at night, in adverse weather and in high-threat environments. It lowers the probability of detection by enemy forces and increases mission success through terrain masking and minimising time spent in threat range. The system also reduces risk to aircrew and the aircraft by balancing low-level terrain clearance altitude with flight safety considerations. MMR modes include: terrain following, low power and low velocity, terrain avoidance, ground mapping, air-to-ground ranging, weather detection, beacon interrogation and cross scan modes. The system's features include ECM resistance, semi-covert operation (power management), low-reflectivity terrain performance and MIL-STD-1553 interface. The AN/APQ-174 is deployed on the US Army Special Operations Command MH-60K and MH-47E aircraft. The APQ-186 is currently being developed for the US Special Operations Command CV-22. Length: 109cm Width: 33cm Weight: 113kg Power consumption: 115V AC 400Hz 2,100VA, 28V DC 38W MIL Standards: MIL-STD-1553 MTBF: 144h specified Turn rate: use of terrain storage for pre-turn and turn-back status, 5.5°/s turn rate

AN/APS-124

The AN/APS-124 is a long-range maritime search and targeting radar originally developed for USN MH-60 Seahawks. It features a number of modes including: long-range search which offers 2m/s duration, pulse-repetition

frequency of 470Hz, 6rpm scan rate and 296km max display range. The medium-range search mode offers one meter per second pulse duration, 940Hz, 12rpm scan rate and 74km max display range. Finally, the fast scan surveillance mode provides 0.5 meters per second pulse duration, 1,880Hz and 120rpm. The system's antenna has a 360° scan capability. The AN/APS-124 includes high mean output power, clutter rejection for detection of small targets in high sea states, digital scan converter for scan-to-scan integration, data link for communication and operations as ship-helicopter team for missile targeting and submarine hunting. Applications: search and targeting Scan rate: long-range search (6rpm scan rate); medium-range search (12rpm scan rate) Operating platforms: USN Seahawk, USN SH-60B, Spanish Navy S-70B-1 Turn rate: 360°

SeaVue

SeaVue is a family of maritime surveillance radars. The systems use colour or monochrome flat-panel displays, PPI and B-scan presentations, multiple high-resolution video formats, ISAR image, range profiling (A-scan) presentation in addition to ISAR images and SAR map. It also features full coherent operation for ISAR, SAR and moving target detection. The SeaVue has a range of modes including small target detection, surface surveillance, navigation and mapping, weather avoidance, ISAR with range profiling and SAR. It also uses a coherent, solid-state, grid modulator TWT transmitter and stabilised, parabolic or flat plate antenna. The system has sector and searchlight capability and integral IFF. Available enhancements include: moving target discriminator, ISAR classification aids, digital map coastline overlay, Doppler beam sharpening, coherent look-down air target detection and tracking. A contract was awarded in November 2015 by the US Army to Leidos to install a SeaVue radar onto a Bombardier DHC-8 aircraft for the Airborne Reconnaissance Low-Enhanced programme, worth $662 million. Applications: family of maritime surveillance radars Scan rate: 6, 60 or 120rpm Weight: antenna 23kg, transmitter 30kg, RESP 37kg Range: typical detection ranges in SS3 – man in life raft 30nm, patrol boat 95nm, tanker 230nm Frequency coverage: 9.4-9.8GHz Power output: 8, 15 or 50kW peak Operating platforms: rotary- and fixed-wing aircraft, ship and land applications

SRC

FORESTER

The Foliage Penetrating (FOPEN) Reconnaissance, Surveillance, Tracking and Engagement Radar (FORESTER) is an airborne radar system that provides stand-off, persistent, wide-area surveillance for situation awareness of foliage covered areas. FORESTER provides real-time, all-weather, day-night target detection and tracking capability for actionable intelligence. The system was designed and developed by SRC under sponsorship from DARPA, the US Army and USSOCOM. It has been tested for use on manned or unmanned helicopters. FORESTER provides UHF GMTI/AMTI/SAR capabilities; real-time onboard processing; and 360° surveillance coverage with electronic beam steering to search a 90° sector. Applications: reconnaissance, surveillance, tracking and engagement Detection range: 15km Operating altitude: 5km Operating platforms: A160 Hummingbird UAS and Black Hawk helicopter

TELEPHONICS

AN/APS-143C(V)3 OceanEye

The APS-143C(V)3 is a family of maritime surveillance, tracking and imaging radars. Features include: 46-frequency pulse-to-pulse agility; TWS of up to 200 targets; five-colour weather avoidance mode; sea MTI; integral IFF; built-in display/control generator; scan-to-scan integration; SART beacon detection. Antenna: stabilised, planar array; full 360°; 45-360° sector scan; searchlight; optional integral IFF interrogator antenna/RT/processor; optional integrated ESM antennas; polarisation V or H; azimuth accuracy 0.5°. Power: 8kW peak from helix TWT, no special cooling needed. PW: 0.1, 10, 23.4 or 40µs. Modules: antenna/pedestal; transceiver; signal processor. Interface: MIL-STD-1553B; optional RS-422, ARINC 429; interfaces for FLIR steering, ESM, data link, recording. Weight: typically 80kg with full capability set; display extra. Options: integrated AIS receiver; moving map display; target data hand-off for Penguin missile; oil slick detection optimisation; iceberg detection/mapping optimisation. Part of the roll-on electronic Mission Systems Pallet (MSP) for the USCG's HC-144A Ocean Sentry MPA. Status: in production, more than 200 operational. Applications: ASuW, ASW, anti-mine warfare, combat search and rescue, long-range maritime surveillance and identification, fisheries protection, coastal and border surveillance, contraband control Scan rate: full 360° scan, stabilised with available integrated IFF dipoles Weight: 84.4kg Range: up to horizon at 28,000ft; detects 1m target at up to 45km in SS3; close-in range down to 90ft Power output: 115V, 400Hz, 3-phase, 1.8kVA and 28V, 12V DC Operating platforms: aerostats (anti-drug), C-26, Falcon 20, CN235/HC-144A, C-130, F.27, C-212, Saab 340, Beech F90/100/200, DHC-8, P-3 Orion, S-70B/C, SH-2G, AS565 SAR Resolution: 1m Data interfaces: ARINC 429/571/575, IEEE-802 Ethernet, RS-232/422, serial I/O MTBF: 800h Frequency coverage: X-band, 460MHz MIL Standards: MIL-STD-1553

AN/APS-147

The AN/APS-147 is a multi-mode maritime ISAR for the Sikorsky MH-60R. It provides target imaging, small target/periscope detection, long-range surveillance, weather avoidance, all-weather navigation, short-range SAR and target designation. The system uses a high-throughput signal and data processing and is capable of detecting small targets and displaying them in a high-resolution format. The radar combines low peak-power waveform with frequency agility to detect medium to long-range targets with a reduced threat of ESM interception, and its modular design enables it to maintain upgrade flexibility. The USN will equip 350 MH-60R maritime strike helicopters with the system. Applications: target imaging, small target/periscope detection, long-range surveillance, weather avoidance, all-weather navigation, short-range SAR and target designation Production status: full-rate production and transitioning to the AN/APS-153(V)1 Operating platforms: Sikorsky MH-60R

AN/APS-153(V)1

The AN/APS-153(V) was designed by Telephonics to meet the requirements of the maritime military helicopter environment. It is rugged, lightweight, low-prime power, capable of small target detection, high resolution imaging and long-range surface search. The system provides the MH-60R and its host ship with littoral and

maritime domain awareness. It supports a range of carrier and expeditionary strike group and US Navy missions, including: anti-submarine warfare, anti-surface warfare, C4SIR, surface surveillance, maritime interdiction, CSAR/SAR, MedEvac, logistical support, identification friend or foe, battle damage assessment and naval surface fire support. Radar operators are able to classify detected moving ship targets under night and restricted visibility, using the high-resolution Inverse Synthetic Aperture Radar (ISAR) mode. This mode allows the MH-60R to operate outside of visual and lethal range of a potential enemy and to identify detected targets when images are combined with other intelligence. The AN/APS-153(V) is fully integrated into the MH-60R Common Cockpit avionics suite by Lockheed Martin. It is controlled through the aircraft's mission computer with returns shown on 8x10in colour multi-function displays, providing the crew with independent views of radar data. The system's signal processing provides upgrade flexibility to enable future advancements. Applications: multi-mode radar Production status: full-rate production Operating platforms: MH-60R

RDR-1400C

The RDR-1400C is Telephonics' search and rescue and weather-avoidance radar system. The radar's weather detection system has a 240nm maximum display range and for close-ups provides two modes, permitting selection of full-scale ranges of either one or 0.5nm, designed to enhance precision of movement. The weather alert feature flashes a warning whenever third-level (red) weather areas are detected, up to 25nm beyond the selected range. The airborne surveillance system has three specialised search modes. Search one incorporates special sea clutter rejection circuitry to help detect small boats or buoys down to a minimum range of almost 300m. Search two is designed for precision ground mapping, where high target resolution is important. Finally, search three includes normal ground mapping and can also be used to detect and track prominent land objects and coastlines. The RDR-1400C provides features such as full-colour presentation of weather returns, auto pitch/roll correction, pilot-selectable antenna tilt and scan angle and BIT. The system is also capable of locating a 9m target in SS2 from up to 10nm away, while operating at a typical helicopter altitude of 500ft. Applications: weather, precision ground mapping (2 modes), navigation, beacon navigation and tracking/search, oil slick detection Scan rate: antenna – planar in 4 different sizes; sector scan 60° and 120°; scan rate 28°/s Weight: 15.4kg (RDR-1400C-106); 10.7kg (RDR-1400C-107) Detection range: 160nm max Frequency coverage: I-band Production status: in production Minimum detection range: 300 or 150m Power output: 10kW peak Operating platforms: Cougar, Super Puma, HH/MH-60, SH-3, Mi-8, H155, AB-212, AB-412, AW101, Bö 105, Oryx, S-61

RDR-1500B

Telephonics' RDR-1500B search and surveillance and weather avoidance radar system is designed to provide multi-mode radar capability for helicopters and fixed-wing aircraft in low and medium altitude maritime missions. The primary mission of the RDR-1500B is as an airborne search and surveillance radar system for sea search operations. Secondary missions include terrain mapping, weather avoidance, beacon navigation and display of navigation information from the aircraft navigation system. The system is also compatible with night vision goggles. The system is comprised of five LRUs: the receiver-transmitter, colour indicator, antenna and drive, interface unit and control unit. The RDR-1500B is customisable to meet user airframe and operational requirements. Among these options are a choice of two different sized radar multi-function indicators; a nine-inch console display and a six-inch cockpit display. Another available option is a 120-degree forward sector scan antenna and drive. The radar system offers standard display modes including aircraft heading reference, north oriented and ground reference. Additionally, the RDR-1500B has target marker capability which allows the operator to determine range and bearing of a target from the aircraft and also relative range and bearing between targets. Three basic operations are provided by the system: surface search and detection with sea-clutter rejection, weather avoidance and radar beacon interrogation and display. The colour indicator displays the radar returns and will also interface with aircraft navigation systems to display information such as search patterns, waypoints and flight log information. Applications: land and sea surveillance Scan rate: 45°/sec - 90°/sec 28°/sec (120° sector scan) Weight: 34kg for RDR-1500B; 23kg for RDR-1553 Elevation: 10.5° Production status: in production Power consumption: 400Hz at 35V Operating platforms: HH-65 Dolphin, A109, AB-412, AS555 N, AS355, Super Puma, Cougar, Lynx, SH-3 Frequency coverage: 200, 800 or 1,600Hz Pulse width: 0.1, 0.5 or 2.35ms Power output: 10kW

RDR-1600

The RDR-1600 is a SAR weather avoidance radar system selected for Danish EH101s. The system provides a full-colour presentation of weather returns, auto pitch/roll correction, pilot selectable antenna tilt and scan angle and built-in-test for a range of operational modes. These modes include weather detection and weather alert, SAR, surveillance, beacon detection and ground mapping. The RDR-1600 offers a 445km display range and detailed close-ups at ranges of 2km or 1km, allowing for safety and precision of movement to plan weather avoidance manoeuvres. The weather alert feature provides operators with a warning whenever third-level (red) weather areas are detected up to 46km beyond the selected range. The RDR-1600 also provides three specialised search modes: search one incorporates special sea clutter rejection circuitry to help detect small boats or buoys down to a minimum range of 130m. Search two is designed for precision ground mapping where high-target resolution is important and search three includes normal ground mapping used to detect prominent land objects or coastlines. The system enables land or sea approaches within 60m ceiling and 1km visibility minimums. Its beacon modes allow detection of DO 172 two-pulse and six-pulse beacons and enables operators to easily change between modes. The RDR-1600 is available with four different antenna sizes focused on the detection of small targets while operating at a typical helicopter altitude of 152m. Applications: SAR, weather avoidance Scan rate: 28°/s Length: 35.6cm Width: 12.7cm Weight: up to 14kg for receiver/transmitter, antenna and drive, and control panel Minimum detection range: 450ft Frequency coverage: X-band Operating platforms: EH101, helicopters and fixed-wing aircraft Power output: 10kW Antenna dimensions: 25, 30, 45 or 30 x 45cm

RDR-1700

Telephonic's RDR-1700 is a lightweight, X-band and 360° digital colour radar system designed for fixed- or rotary-wing aircraft engaged in maritime patrol, surveillance, rescue missions and precision terrain mapping. The system can also be configured in numerous system configurations. The system offers display modes including: aircraft heading reference, north reference, ground reference and display offset. Using these modes, operators are able to determine range and bearing (latitude/longitude) of a target from the aircraft and relative range and bearing between targets. The system also has the capability to offset the sweep centre to any location on the display. It also provides four operating modes: surface search with sea-clutter rejection/terrain mapping, weather alert and avoidance, radar beacon interrogation and identification and test mode with continuous built-in-test. The RDR-1700interfaces with aircraft navigation systems to display radar returns, search patterns, waypoints and flight log information. Applications: SAR, detection of small vessels Scan rate: 45°-90°/s (360° sector scan); 28°/s (120° or 180° sector scan) Weight: 27kg Operating platforms: helicopters, fixed-wing aircraft Power consumption: 400Hz Pulse width: 0.1/0.5/2.35usec Power output: 10kW

RDR-1700B(V)1 & AN/ZPY-4(V)1

The RDR-1700B(V)1 and AN/ZPY-4(V)1 radar systems are designed for maritime surveillance, tracking and classifying targets of interest in a range of applications including naval aviation, maritime police, border patrol as well as environmental and fisheries protection. The systems are capable of tracking multiple targets and can be found on fixed- and rotary-wing aircraft as well as UAVs, enhancing situation awareness. Modes include ISAR, SAR, weather detection and avoidance as well as SART beacon detection. In January 2013 AN/ZPY-4(V)1 systems were selected to be installed on USN Fire Scout MQ-8B UAVs. Applications: multi-mode maritime surveillance radar Operating platforms: fixed- and rotary-wing UAVs, small manned surveillance aircraft Production status: in production

THALES

DAV

Thales' DAV warning and surveillance radar enables crew to detect, track, identify and designate air threats from a safe distance. The system is installed above the helicopter rotor to enable 360° situational awareness with 24° elevation. This has been designed to enable operation whilst the helicopter is partially masked, taking cover behind natural obstacles. Thales designed the system to meet requirements including all weather and 24-hour operation, short reaction time to counter threats, integration in the helicopters weapon system, easy preparation and operation, low weight and power consumption. The DAV is composed on solid-state, microwave hybrid and VLSI circuit techniques, integrated by Thales to provide compact assembly that operates in a mechanical and EM severe environment. The DAV's operational functions include the detection of airplanes and helicopters flying at low and very low altitudes, detection of helicopters in hover, recognition and classification of targets as airplanes or helicopters, identification of helicopter types by library references, multi-target TWS, measurement of detected and tracked target parameters and accurate target localisations and designations to the weapon system. Weight: 60kg Elevation: 24° Power consumption: 800W Turn rate: 360°

Horizon

Horizon is an I-band long-range ground surveillance radar. The primary sensor is mounted on the AS532 UL Cougar and feeds information to a ground station in a 5t truck via a data link. The frequency coverage of the Horizon system is 8-12GHz (I/C-band) whit operating modes including high-resolution ground mapping, MTI, fixed echo indication and ELINT. The system's resolution is 40m in range, 2m/s in velocity. Its scanning capabilities include combined mechanical and electronic, sector width of up to 360° at any sector axis and with a rate of 2, 4 or 8°/s. Horizon also features panoramic surveillance of 20,000km² in 10s, and is able to perform target location, classification and speed measurement tasks while scanning. Horizon is compatible with helicopters, wheeled and tracked vehicles and others. Applications: long-range ground surveillance Scan rate: combined mechanical and electronic, sector width up to 360°, any sector axis, rate 2, 4 or 8°/s Detection range: 200km (clear weather), 150km (rain and clouds) Operating platforms: AS532 UL Cougar Frequency coverage: I-band Data link range: 100-150km

Ocean Master

The Ocean Master is a sea surveillance and patrol radar for detection of all types and sizes of targets in all sea states. It has been sold to the French Navy and export customers. The wideband frequency agility of the Ocean Master makes it resistant to countermeasures and improves detection performance in sea clutter, it is claimed. The three-LRU system comprises one exciter receiver processor, one transmitter (TX) and one antenna unit. The system is capable of installation on rotary- and fixed-wing aircraft. Ocean Master missions include long-range detection of up to 370km for blue/brown water surveillance. It is also capable of surveillance missions in high-traffic density areas and EEZs. Other tasks include illegal immigration control, fisheries protection, anti-smuggling, trafficking control, counter-piracy, prevention of asymmetric threats and search and rescue. The radar's main features include air target detection mode, navigation and weather avoidance modes, dynamic range profile, multi-target TWS of up to 200 tracks, MTI and oil spill detection. The Ocean Master was installed as part of a joint Thales-PAL Aerospace upgrade of two UAE Air Force Q300 MPAs. The radar was installed along with a mission system based on Thales' AMASCOS. Applications: sea surveillance, target detection Weight: <85kg including HMI Range: 445km Production status: in production Target tracking: TWS - 200 targets Power consumption: 2.1kW

Searchwater 2000

The Searchwater 2000 is a heliborne AEW radar. It was selected for the upgrade of the UK RN's AEW Sea King fleet to Mk 7 standard. The system comprises a high-power pulse-Doppler radar integrated with Mk XII, ESM and an INS/GPS navigation. The system also includes an HMI specifically designed for AEW operations, using twin consoles for more effective operator interaction. Data communications between interceptor aircraft and other C2 assets can be via a range of links such as JTIDS, Link 16, Link 11 and the future Link 22. The system is

light enough to be installed in a range of fixed-wing aircraft or helicopters operating from shore or afloat. The Searchwater 2000AEW system provides long-range warning against high and low level attack, intercept direction of fighter aircraft using a high-resolution INS/GPS, an autonomous secure air defence C2 unit, a maritime surveillance system providing detection of very small, fleeting targets including periscopes, against high background clutter. It also provides an extension of surface-based systems to provide OTH targeting, search and rescue and coastal surveillance and special enforcement operations. The radar in the Searchwater 2000AEW system incorporates multi-bar scanning for multiple-level raid detection. Pulse-Doppler/pulse envelope interacting allows targets to be detected at maximum range and tracked through background clutter. Operator facilities provide for manual and automatic multiple-target tracking. Intercept information can be continuously relayed to the interceptor aircraft or surface-based assets via data link or voice. An improved version of Searchwater 2000 was selected in May 2015 for installation on RN Merlin HM2 helicopters under the Crowsnest programme to provide a replacement capability for the Sea King ASaC7 in 2018.The UK MoD in January 2017 announced that manufacturing of the Crowsnest system for its fleet of 30 Merlin Mk 2s would begin, following the award of a £269 million ($376 million) deal to prime contractor Lockheed Martin. Thales has been subcontracted to deliver the upgraded Searchwater radar and Cerberus mission system, while Lockheed Martin will integrate the Crowsnest onto the helicopters. Ten role fit kits will be produced as well as a full fleet modification. Applications: AEW

SONARS

L3 OCEAN SYSTEMS

AN/AQS-13F

The AN/AQS-13F is a long-range, active scanning sonar that detects and maintains contact with underwater targets through a transducer lowered into the water from a hovering helicopter. The system provides target classification clues and can accurately determine the opening or closing rates of moving targets. Active echo-ranging determines the target's range and bearing. The AN/AQS-13F has been designed to provide rapid tactical response against the most advanced submarine threats. It's high speed reeling allows a dip cycled to maximum depth to be completed within 3.5min. The azimuth and range indicator and receiver provide a video display for the operator. The system's Sonar Data Computed (SDC) uses digital processor techniques which enhances detection capabilities in shallow water and reverberation-limited conditions while essentially eliminating false alarms from the video display. The higher energy transmitted with the longer pulse SDC mode, combined with the narrowband analysis improve the figure of merit in non-reverberant conditions more typical of deep water operations. The AN/AQS-13F can be upgraded through the replacement of the receiving, processing and display units. The upgrade offers a 14dB improvement and an FM mode. It also offers the potential for embedded training, performance prediction and a further option of upgrading to a low frequency transducer system which, according to the company, offers a performance capability comparable to a surface ship sonar. The system is currently in use with the USN. Applications: detect and localise underwater targets Weight: 284kg Depths: 440m

AN/AQS-18A

The AQS-18A is a mid-frequency helicopter dipping sonar system designed for active, long-range search, localisation and attack of submarines in both shallow and deepwater environments. the sonar detects and maintains contact with underwater targets through a transducer lowered into the water from a hovering helicopter. Active echo-ranging determines the bearing, range and operating or closing rate of the target relative to the position of the helicopter. The dipping sonar features long pulses, high source levels, FM capability, 16-beam signal processing and a 37km coverage range. The AQS-18A system is fully compatible with MIL-STD-1553B databus architectures to facilitate integration with aircraft subsystems and components. Interfaces are provided to accept input data and provide graphic and data outputs to a sonics data recorder, as well as video for sensor data display. The AQS-18A wet end consists of small high-density transducer assembly, a 440m cable and compatible reeling machine and dome control. The dry end consists of the sonar interface unit, cable interface power supply and sonar control unit. The sonar interface unit has powerful signal processing algorithms specifically designed for increased pulse lengths and spare processing space for additional processing features such as computer-aided detection and classification, multi-sensor target fusion, embedded training and performance prediction based on environmental data collected during past or current missions. The sonar control unit provides simple interface menus for operator command and control of the sonar system. Optional dry-end subsystems include cable payout indicator, bearing-range indicator and multifunction display. Weight: 88.9kg (transducer assembly); 122.7kg (dome control, reeling machine, cable and reel); 51.8kg (sonar interface unit, cable interface power supply and sonar control unit); 264kg (total) Pulse lengths: additional 1.6, 3.2 and 4s pulse lengths Production status: AQS-18As have been delivered to four nations Depths: 440m

DS-100 HELRAS

L3 Communications' Helicopter Long Range Active Sonar (HELRAS) DS-100 is a helicopter dipping sonar. The wet end comprises a descending vertical transmit array of seven projector elements and a receive array of eight hydraulically driven arms which expand to a diameter of 2.6m when deployed. The DS-100 is capable of operating at depths of up to 500m and has a figure of merit sufficient to achieve second convergence zone detection in deep water and unparalleled direct path coverage. Low strength targets moving at slow speeds are detected through the use of high-resolution Doppler processing and long shaped pulses. Extended duration wide bandwidth FM pulses (up to five seconds) are available to detect the near-zero Doppler target as well. The low (1.8kHz) active centre frequency designed into the DS-100 using proprietary transducer and beam-forming technologies allows multiple boundary interactions, reduced reverberation contamination of the received signals and interoperability with shipboard sonars and sonobuoys in bistatic or multistatic employment. In addition to its long-range surveillance

The Raytheon Airborne Low-Frequency Sonar is the primary undersea warfare sensor for the USN MH-60R Seahawk. (Photo: Raytheon)

and search capabilities, the DS-100 is well suited to redetection, target localisation and weapon delivery against deep and shallow water targets. The sonar system is fully compatible with MIL-STD-1553B databus architectures and its advanced reeling machine evolved from the field-proven AQS-13/18 series. Weight: 326kg (integrated system); 341.3kg (standalone system) Operating platforms: SH-3, EH101, NH90, SH-60 and S-70, CH-148 Cyclone, AS532 Cougar Depths: 500m Pulse lengths: 5 seconds

RAYTHEON

AN/AQS-22 ALFS

The AN/AQS-22 Airborne Low-Frequency Sonar (ALFS) is the primary undersea warfare sensor for the USN MH-60R Seahawk multi-mission helicopter. The sonar system enables the MH-60R to accomplish the ASW missions of submarine detection, tracking, localisation and classification, as well as acoustic intercept, underwater communications and environmental data acquisition. The AN/AQS-22 delivers a range of features not found in the USN's previously failed helicopter dipping sonar system, according to the company. It has been integrated with the MH-60R helicopter, other battlegroup assets and the MK 54 lightweight torpedo to provide the full detect to engage ASW capability. The system comprises seven weapon replaceable assemblies: acoustic processor (government-furnished AN/UYS-2A enhanced modular signal processor equipment); sonar transmitter/receiver; reeling machine interface unit; reeling machine control unit; reeling machine; reel and cable and transducer assembly (TA). Thales supplies its Folding Light Acoustic System for Helicopters for the project. Applications: ASW Reel cable systems: nominally 760m of co-axial cable Operating platforms: MH-60R Production status: entered full-rate production in 2004

THALES

FLASH

The Folding Light Acoustic System for Helicopters (FLASH) is a low-frequency, wideband dipping sonar. It features a new, open-architecture common acoustic processor with integrated VHF receiver for concurrent sonobuoy processing capability. FLASH offers optimisation between mechanical performance (weight and volume) and acoustic performance (optimal frequency). It delivers acoustic performance or submarine detection, classification and tracking in both deep and shallow water environments worldwide. The system features a choice of three frequencies between three and five kHz, omni-directional transmission mode, FM, CW and COMBO pulse modes and an operating depth of 750m. The system's operator aids include active and passive raw data displays, panoramic/geographic display, auto-alert management, automatic multiple target tracking, performance prediction and optimum depth tools and an automated BITE/system health monitoring capability. The FLASH family has been used by aircraft including: NFH90, MH-60R, Cougar, Merlin EH 101 and the MH60-R. Weight: 306kg Operating platforms: French Navy NH90, Royal Norwegian Air Force NH90, Swedish Navy NH90, UAE Naval Force Cougar, UK RN Merlin and USN MH-60R Depths: 750m Production status: over 120 systems have been delivered with annual production of about 30 units

TMS 2000

Thales developed the TMS 2000, a sonobuoy processing system based on experience gained at sea with the Australian, UK and French multi-static programmes. It has been designed to counter the evolution of the submarine threat, which has seen submarine radiated noise levels and target strength at their lowest levels. At the heart of the TMS 2000 is a new common acoustic processor, which can simultaneously process up to 64 sonobuys, including all NATO and Australian analogue and digital types. Processing techniques provide extensive data fusion, a full set of classification aids and functionality for a mission ground centre for planning, analysis and training elements. The TMS 2000 features comprehensive classification functions, full colour HMI for active and passive geographic energy and raw chain data displays, digital wide-band VHF sonobuoy receiver with 99 channels, comprehensive mission preparation, post-mission fast0time replay/analysis and simulation for operator training and functionality for acoustic processing ground centre. Interfaces include: NFH90, CN 235 MPA, ATR 72 MPA, DASH-8 MPA and MERLIN. Applications: ASW Operating platforms: ASW helicopters integrated with FLASH dipping sonar

SPECIFICATIONS

WEAPONS

This section features a selection of major weapon systems designed or adapted for use on helicopters. Although many of these systems can be mounted on air, ground or naval platforms, only helicopter applications are included in these listings. As most light, medium and heavy machine guns can be fired from a helicopter, only the weapons most widely deployed on pintle, fixed and pod mounts are described here.

The weapon systems specifications include:

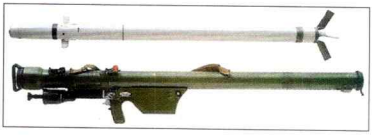
- Air-to-air missiles (AAMs)
- Air-to-ground missiles (AGMs)
- Anti-ship missiles (ASMs)
- Guns, pods and turrets
- Launchers
- Rocket systems (guided and unguided)
- Torpedoes

Information has been supplied by the manufacturers.

If your company produces a weapon system that you believe should be listed in this section, please contact Karima Thibou at karima.t@shephardmedia.com to ensure it appears in the Shephard Plus online database (shephardplus.com) and is included in the next print edition.

ABOVE: US soldiers load an AGM-114 Hellfire missile onto an AH-64E Apache before a mission in Kunduz, Afghanistan. (Photo: USN)

Air-to-air missiles ▸ KBM ▸ 9M32 Strela-2



The 9M32 Strela-2 is a helicopter-launched version of the ubiquitous Russian first-generation shoulder-launched short-range SAM, the 9K32. Designated by the US DoD as the SA-7A with missile round 9M32, it entered Soviet military service in 1968. Operating with a high explosive warhead and passive IR homing guidance system, the initial model experienced several shortcomings, such as poor interception, guidance and lethality. Two improved version were soon ordered, the Strela-2M and more ambitious Strela-3. Although not simply a case of reverse-engineering, the system is comparable to the US Army FIM-43 Redeye. It has seen action in most regional conflicts since 1968. **Max speed:** supersonic **Range:** 4km **Missile weight at launch:** 10kg **Missile diameter:** 70mm; wingspan 30cm unfolded **Propulsion:** single-stage solid rocket motor **Guidance:** passive IR homing **Operating platforms:** SOKO-built Gazelles, Mi-2, Mi-24/25/35 **Missile length:** 1.34m **Warhead type:** 1.8kg HE fragmentation

MBDA ▸ Mistral ATAM

The Mistral ATAM is a fire-and-forget AAM system which uses the Mistral SAM modified for the air-to-air role. It is in operational service on French Army Gazelles and qualified on the Tiger. The system is based upon two launchers each bearing two misiles and connected to helicopter combat system. With a minimum intercept range of 500m, the Mistral ATAM ensures a large off-boresight capability and the ability to aim the missile seeker precisely at its target. **Max speed:** M=2.5 **Range:** 5km+ **Rate of fire:** up to one missile every 3s **Warhead type:** 3kg HE, tungsten ball **Missile weight at launch:** 18.7kg at launch **Propulsion:** solid rocket motor **Missile diameter:** 90mm **Guidance:** passive IR homing, proportional navigation **Operating platforms:** can be mounted on attack helicopters fitted with an integrated combat system (Tiger, Rooivalk), lightweight helicopters (Gazelle, Fennec) and utility helicopters (Cougar) as a standalone weapon system **Missile length:** 1.86m

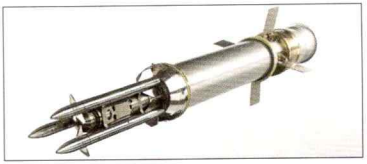
Raytheon Missile Systems ▸ AIM-9 Sidewinder

The AIM-9 Sidewinder is a short-range air-to-air missile that entered US military service in 1956, with variants and upgrades remaining active to the present day. The heat-seeking AIM-9X Block 1 Sidewinder is the most widely used AAM on US and allied fighter aircraft and can be mounted on helicopters. The majority of Sidewinder variants use IR homing for guidance, and of over 110,000 missiles produced around the world 1% have been used in combat. **Max speed:** M=3 **Range:** 16km **Rate of fire:** dependent on ability of helicopter's sighting systems to acquire new targets and cue missile seeker heads **Warhead type:** 9.5kg HE blast fragmentation with laser proximity **Features:** imaging seeker, thrust vector control, off-boresight capability and high countermeasure resistance **Propulsion:** solid rocket motor **Missile diameter:** 12.7cm **Guidance:** imaging IR, proportional navigation **Operating platforms:** USMC Bell AH-1W SuperCobra and AH-1Z Viper attack helicopters **Missile length:** 3m

Raytheon Missile Systems ▸ AIM-92 Stinger

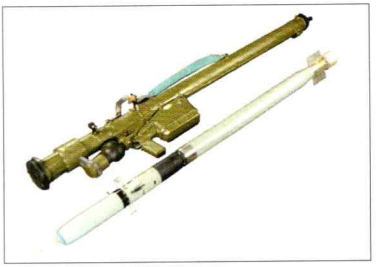
The Air-to-Air Stinger (ATAS) system, also known as the AIM-92 Stinger, is developed from the shoulder-launched FIM-92 Stinger (see separate entry) and uses the same Stinger-RMP (Reprogrammable Microprocessor) missile. The US Army has used the ATAS on its OH-58D Kiowa Warrior and UH-60 Black Hawk helicopters (see separate entries) in an air-to-air capacity. In December 2002, an Iraqi MiG-25 shot down a Predator drone (see separate entry) that was armed with Stingers. The Predator retaliated after being fired upon, but the Stinger likely became distracted by the MiG's missile and missed its target . **Max speed:** supersonic **Propulsion:** solid propellant, dual thrust **Guidance:** passive dual-mode IR/UV homing, fire-and-forget, proportional navigation with lead bias **Operating platforms:** OH-58C, OH-58D Kiowa Warrior, UH-60L/M, AH-64D/E Apache; selected by German Army for Tiger and Italian Army for A129 **Missile length:** 152cm **Warhead type:** blast **Missile diameter:** 2.75in

Thales UK ▸ Starstreak



The Starstreak AAM is a variant of the Thales hypervelocity SAM. After its launch, the missile accelerates to speeds of M=4, making it the fastest short-range surface-to-air missile in the world. Once in flight, the Starstreak launches three laser beam riding submunitions that increase the chance for a successful hit. The missile has been in service with the British armed forces since 1997. **Max speed:** hypersonic **Range:** 6km+ **Rate of fire:** engagement of one target must be completed before another can be fired upon, but engagements are over very quickly **Warhead type:** 3 individually guided armour-piercing explosive darts with delay fuse **Missile weight at launch:** 16.78kg **Launcher:** 2-tube box **Missile diameter:** 130mm; wingspan 250mm **Propulsion:** 2-stage rocket motor **Guidance:** laser beam riding darts steer themselves into centre line of 'grid' created by vertical and horizontal scanning lasers; helicopter sights automatically keep centre of grid on target **Missile length:** 1.4m

V. A. Degtyarev Plant ▸ 9M39 Igla-V

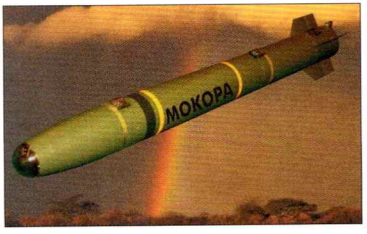


The 9M39 Igla-V ('Needle') is a Russian shoulder-launched IR homing SAM adapted for helicopter use. It is an air-launched version of the Igla MANPADS. The 9M39 relied on a two-colour IR guidance system that lessened the threat of flares and was propelled by a single solid fuel rocket motor. With an operational range of 5.2km and a ceiling of 11,000ft, the 9M39 reached speeds of M=2.3. The missile was almost as long as the launcher itself and had spring-loaded fins for inflight stabilisation. It is used by many nations, including Egypt, Iran, Syria, Ukraine and Vietnam. It is currently being phased out by Russian armed forces in favour of the 9K333 Verba. **Max speed:** supersonic **Range:** 5.2km **Missile diameter:** 7.2cm; wingspan 35cm **Propulsion:** solid rocket motor **Guidance:** passive IR homing **Operating platforms:** Mi-8/17, Mi-24, offered as option on Mi-35 for export customers, Ka-50 **Missile length:** 1.55m **Warhead type:** 2.5kg HE fragmentation with impact fuse

Air-to-ground missiles ▸ Denel Dynamics ▸ Ingwe

The Ingwe ('Leopard') is a multipurpose guided missile developed from the ZT3 family primarily for antitank purposes. Passive target acquisition, high countermeasure resistance and ease of use are claimed. In February 2013, a new variant was unveiled at the International Defence Exhibition in Abu Dhabi. Named the Portable Launch System. **Max speed:** high subsonic **Range:** 250-5,000m **Warhead type:** tandem-shaped charge with precursor warhead in tip of nose probe, claimed to penetrate 1,000m of RHA after defeating explosive reactive armour, alternative thermobaric and multipurpose penetrator warheads **Propulsion:** launch motor and boost motor **Guidance:** laser beam riding; missile follows centreline of laser scan pattern, helicopter use requires stabilised sight, automatic target tracking modules can be added to ensure fully automatic guidance after lock-on **Operating platforms:** Mi-24, Mi-17, H135M **Missile length:** 1.75m **Missile diameter:** 127mm

Denel Dynamics ▸ Mokopa



The Mokopa is a long-range precision-guided missile, made in South Africa. Designed as an antitank weapon, it is currently in the final stages of development before being integrated into the South African Air Force Rooivalk attack helicopters (see separate entry). The system is currently in use with Algerian National Navy within their six new Super Lynx 300-series helicopters (see separate entry). **Range:** >10,000m **Rate of fire:** various modes including ripple fire capability **Launcher:** Full MIL-STD-1760/-1553; strap-on configurations also available; four- or two-rail launcher **Warhead type:** tandem-shaped charge and alternative multipurpose warhead **Propulsion:** solid rocket motor **Guidance:** semi-active laser; can be fitted with IR fire-and-forget and millimetre-wave radar-homing versions, full inertial navigation allows accurate guidance for various launch modes **Launcher diameter:** 178mm Launcher **length:** 1.99m **Operating platforms:** Rooivalk, Super Lynx

KBM ▸ 9M114 Shturm-V

The 9M114 Shturm-V (NATO reporting name AT-6 'Spiral') is a third-generation Russian short-range anti-armour missile system. Meaning 'assault' in German, the Shturm is a Soviet-made semi-automatic command to LOS (SACLOS), radio guided antitank system that uses a 9M114 Cocoon missile. The missile can be deployed on air, land or sea platforms and is transported and launched from a glass-reinforced plastic tube. The SACLOS has a radio command link that allows the missile to travel to travel faster and further than a guided one. **Max speed:** supersonic **Range:** 5km **Rate of fire:** engagement of one target must be completed before another can be engaged **Missile diameter open wingspan:** 30cm **Missile weight at launch:** 30kg **Propulsion:** solid rocket motor **Missile diameter:** 14cm **Guidance:** dual-mode radio command followed by semi-active laser terminal homing **Warhead type:** 10kg, tandem HEAT-shaped charges **Operating platforms:** Mi-24E/F, Ka-29, offered as option on Rostvertol Mi-35 for export customers, Mi-28 and Mi-8/17 **Missile length:** 1.78m

KBM ▸ 9M120 Ataka-V

An improved version of the 9M114 (see separate entry), the 9M120 Ataka-V is a long-range antitank guided missile that is equipped with a tandem HEAT warhead. The 9M120 (NATO reporting name AT-9 'Spiral-2') uses laser-beam riding guidance and is optimised for target engagements in visual conditions. Tracking is provided by the GOES-451M optronic payload. Stored in a glass-reinforced plastic tube that acts as its launcher, the 9M120 Ataka-V entered service with the Russian military in the early 1990s and will be equipped on the Mi-28NM helicopter for Russian Army Aviation. The missile's primary variant was designed to defeat tanks with composite armour and explosive reactive armour. **Max speed:** supersonic **Range:** 8km **Operating platforms:** Mi-28

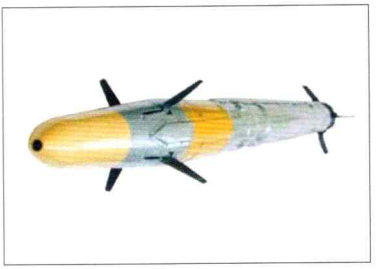
KBM ▸ 9M123 Khrizantema

The 9M123 Khrizantema (NATO reporting name AT-15 'Springer') is an antitank missile designed to engage slow and low-flying aerial targets. The missile can be employed without the need for visual contact; its targeting is provided via a millimetre-wavelength radar suspended on one of the underwing pylons of the helicopter. The 9M123 Khrizantema entered service with the Russian armed forces in 2005 and will be equipped on the Mi-28NM helicopter for Russian Army Aviation. **Max speed:** supersonic **Range:** 6km; 8km (extended-range derivative) **Warhead type:** Tandem HEAT shaped charges

KBP Instrument Design Bureau ▸ Hermes

Hermes is a two-stage supersonic missile designed for helicopters as well as fixed-wing strike aircraft. A typical system includes missiles packaged in transport/launch tubes, control equipment, two launchers and maintenance equipment. Hermes consists of a multistage rocket missile with a booster, as well as a fire-and-forget capability, with laser guidance and IR homing. Designed to engage multiple targets, it can track and destroy over-the-horizon them in single or volley fire. **Applications:** current and future tanks, lightly armoured vehicles, fortifications and buildings, surface and low-velocity air targets **Max speed:** 1,000m/s **Range:** 15-20km **Rate of fire:** 2-round salvos against different targets **Missile weight at launch:** 110kg in tube **Warhead type:** 28kg HEF **Guidance:** inertial and radio command to target area, then *terminal homing* **Operating platforms:** Ka-52 carrying 16 on 4x four-round launchers **Missile length:** 3.5m

KBP Instrument Design Bureau ▸ Vikhr



Vikhr ('Whirlwind') is a large dual-purpose antitank/AAM. It is a Russian laser-guided antitank missile launched from air, land or sea. The missile is designed to engage armoured ground targets that are equipped with explosive reactive armour. Vikhr-M, adopted in 1990, is an improved version that includes an automatic sight and a depressible launcher. The automatic sight is provided with TV and IR channels for target sighting, a laser beam channel for missile control, a laser rangefinder, an automatic target tracking unit, a digital computer and a system for stabilisation and aiming the sighting and beam channels. **Applications:** antitank/AAM **Max speed:** supersonic **Range:** 8km-10km max **Rate of fire:** engagement of one target must be completed before another can be engaged **Propulsion:** solid rocket motor **Warhead type:** dual-mode, shaped charge for armoured targets, blast fragmentation with proximity fuse for airborne targets **Guidance:** laser beam rider **Operating platforms:** Mi-8/17, Mi-24, Mi-28, Ka-52 **Missile length:** 1.5m

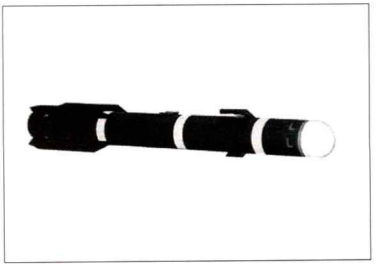
Lockheed Martin ▸ JAGM

In February 2014, Lockheed Martin demonstrated the JAGM dual-mode guidance section, engaging a laser-designated moving target during an internally funded flight test. With open-system architecture, the dual-mode seeker includes the same precision-strike semi-active laser and all-weather fire-and-forget millimetre-wave radar sensors demonstrated in prior JAGM guided flights. Lockheed Martin delivered its proposal to the US Army for the JAGM programme in April 2015. The JAGM was demonstrated in July 2015, engaging two stationary targets at the USAF's Eglin base in Florida. On 31 July 2015, it was announced that the company had won a contract for the EMD phase of JAGM for the US Army and Navy. The EMD will allow JAGM to reach Milestone C which will be completed in late 2017 – the contract allows for 189 JAGMs to be manufactured during this phase of development.

Lockheed Martin Missiles and Fire Control ▸ AGM-114K/KA/M/N Hellfire II

The Hellfire II family includes four SAL seeker warhead variants: AGM-114K, a HEAT warhead designed to defeat all current and projected threats; AGM-114KA, an augmented HEAT warhead that adds blast fragmentation to the antitank capability for precision strike against targets in the open; AGM-114M, a blast fragmentation missile designed to defeat buildings, bunkers, light armoured vehicles and boats; and AGM-114N, a round equipped with a metal augmented charge warhead designed to defeat enclosed structures with minimum collateral damage. All variants are combat-proven. **Range:** 0.5-8+km **Operating platforms:** MQ-1 Predator, MQ-9 Reaper, AH-64, AH-1 series, Tiger, OH-58D

Lockheed Martin Missiles and Fire Control ▸ AGM-114L Longbow Hellfire II



The AGM-114L is a radar-guided version of Hellfire II developed for the AH-64D Apache. Able to be deployed from a variety of air, land and sea platforms against a wide range of targets, the missile is used in Operation *Enduring Freedom* and Operation *Iraqi Freedom*. It is radar guided as opposed to laser guided, and operates with a fire-and-forget millimetre-wave radar seeker coupled with inertial guidance. **Max speed:** supersonic **Range:** 0.5-8km **Rate of fire:** can be fired one after the other as fast as the gunner can pull the trigger **Missile weight at launch:** 49kg **Missile diameter:** 17.8cm **Propulsion:** solid rocket **Warhead type:** tandem-shaped charge **Guidance:** Inertial on co-ordinates from the weapon's processor, using target data from the Longbow radar or the TADS sight, then active millimetre-wave radar homing; for close stationary and all moving targets the homing seeker can lock on before or after launch **Operating platforms:** AH-64D, AH-64E **Missile length:** 1.76m

Lockheed Martin Missiles and Fire Control ▸ AGM-114R Hellfire II

The precision-strike AGM-114R multipurpose Hellfire II consolidates the capabilities of all previous Hellfire II variants equipped with semi-active laser (SAL) seekers into a single missile with a new multipurpose warhead able to neutralise a broad target set, from armour and air defence systems to patrol boats and enemy combatants in buildings, open areas, SUVs or caves. This previously required multiple Hellfire warhead variants. It can be launched autonomously or with remote designation. The missile may be employed by lock-on before launch (LOBL) or lock-on after launch (LOAL). Its new inertial measurement unit provides a wide engagement zone to properly equipped platforms, enabling them to fire upon targets to the side and behind them. **Length:** 1.63m **Width:** 178mm **Range:** 8km (LOAL, high trajectory), 7.1km (LOAL, low/direct trajectory) when launched at 2,850ft **Missile weight at launch:** 49.4kg **Operating platforms:** MQ-1 Predator, MQ-9 Reaper, AH-1 series, AH-64 series **Attack modes:** LOBL, LOAL **Warhead type:** Multipurpose

MBDA ▸ Brimstone

The Dual Mode Brimstone (DMB) – semi-active laser and millimetre-wave radar guided – has been successfully used in Afghanistan and Libya, demonstrating accuracy and reliability rates both above 90%. Brimstone 2, now under development, will incorporate the dual-mode seeker along with a new insensitive motor and warhead. MBDA is offering the DMB and Brimstone 2 for integration on attack helicopters. The company has also released details about the integration of the DMB onto the MQ-9 Reaper UAV. Live-fire testing took place in December 2013 and January 2014, which saw the MQ-9 Reaper UAV carry two missiles at a time. A total of nine weapon releases (all direct hits) were conducted from 'realistic, middle-of-the-envelope profiles'. The testing was conducted by RAF's Air Warfare Centre Unmanned Air Systems Test & Evaluation Squadron. **Length:** 1.8m **Weight:** 50kg **Range:** 12km **Warhead:** tandem HEAT **Missile diameter:** 17.8cm

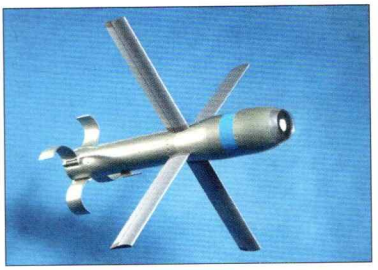
MBDA ▸ HOT 3

Designed to destroy reactive armour, HOT 3 has demonstrated its multipurpose capability with tens of thousands of missiles produced being used by a dozen countries worldwide and during several conflicts. Entering production in 1976, the system was used with the German and French armies, fitted to anti-armour vehicles. The geopolitical climate was such that foreign nations, particularly in the Middle East, were reluctant to become reliant upon the USSR for weapons. **Max speed:** high subsonic **Range:** 0.4-4km **Rate of fire:** engagement of one target must be completed before second missile can be fired **Missile diameter:** 150mm **Propulsion:** solid rocket motor **Warhead type:** tandem-shaped charge **Guidance:** optically tracked, SACLOS, wire passes steering commands to missile **Operating platforms:** Gazelle, Bö 105; German UHT Tigers; fired from Rooivalk, Sokol; being integrated on Mi-24, H135M **Missile length:** 1.3m

MBDA ▸ PARS 3 LR

The PARS 3 LR is a fire-and-forget anti-armour missile with additional air-to-air capability designed for installation on helicopters and ground vehicles. It is intended for long-range applications and designed to defeat tanks and helicopters whilst minimising exposure of the operator. The missile system will be integrated onto Germany's 57 UHT Tigers, and its performance has been validated following a test firings. **Max speed:** high subsonic **Range:** 500-5,000m, extension possible up to 8,000m **Rate of fire:** salvo firings against four targets in less than 10s **Missile length:** 1.6m **Missile weight at launch:** 49kg including launch tube **Missile diameter open wingspan:** 371mm **Propulsion:** solid rocket motor **Guidance:** passive imaging IR using two modes of tracking – image correlation or target hot spot, in conjunction with the Osiris mast-mounted sight **Missile diameter:** 227mm **Warhead type:** tandem-shaped charge **Operating platforms:** UHT Tiger **Attack modes:** dive or direct

MBDA ▸ Viper-E



In November 2011, MBDA bought the Viper-E (previously called Viper Strike) precision munition from Northrop Grumman. Viper-E allows aircraft, helicopters and UAVs to precisely engage targets in urban areas that would otherwise be denied due to the risk of collateral damage. Currently in use with USMC aircraft, the Viper-E glides to target using GPS-aided navigation and a semi-active laser seeker. The new model is optimised for attack profiles that require either a steep or shallow final-attack angle. This feature, alongside a smaller warhead and laser-guidance, allows for a low collateral damage in both mountainous and urban environments, where stringent rules of engagement are in force. The new GBU-44/E Viper-E is capable of stand-off precision attack as well as the new fast-attack mode that is effective against high-speed targets. **Missile weight at launch:** 20kg **Missile length:** 914mm **Missile diameter open wingspan:** 914mm **Missile diameter:** 139mm **Warhead type:** tandem-shaped charge

Norinco ▸ Blue Arrow 7

Blue Arrow 7 is an air-to-surface missile system which has been developed as an anti-armour and precision attack weapon to destroy tanks and other armoured vehicles, and bunkers. It is designed to penetrate armour up to 1400mm and is characterised by an increased warhead capacity at the expense of fuel – which diminishes its range. The system can be mounted on both helicopters and UAVs. During operations, target designation can be conducted by the helicopter's stabilised sights or by a ground-based laser illuminator. According to Norinco, Blue Arrow has a hit probability of 88% or more within effective range. **Range:** 2,000-7,000m **Missile weight at launch:** 47kg **Missile length:** 1.78m **Missile diameter:** 17mm **Warhead type:** tandem HEAT

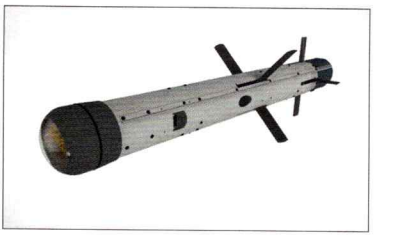
Norinco ▸ Red Arrow 8

The Red Arrow 8 is a second-generation tube-launched, optically tracked, wire-guided antitank missile system developed to meet the requirements of the Chinese People's Liberation Army. Designated locally as the HJ-8 and roughly equatable to the US BG-71 TOW and European MILAN and HOT antitank missiles (see separate entries), various warheads are available optimised for different target sets. Its components are reverse engineered and modified versions of the tripod from the US BGM-71 TOW, the tracker-control unit from the European MILAN and the missile from the UK Swingfire. Pakistan produces the missile system under licence as the Baktar-Shikan and the system has been seen used in the Syrian civil war. **Range:** 100-4,000m **Missile weight at launch:** 25-27kg, depending on model **Missile length:** 1,566mm **Missile diameter:** 120mm **Warhead type:** single, tandem, anti-bunker, fuel-air explosive, anti-ship

Rafael Advanced Defense Systems ▸ Spike-ER

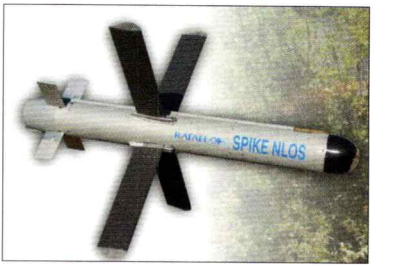
The Spike-ER is a fourth-generation multipurpose missile fitted with EO CCD/IIR sensors for operation during day, night and in adverse weather. The Spike-ER includes a day/night seeker and tandem warhead. It can be equipped with a variety of warheads for a range of combat scenarios. Lofted trajectories enable the warhead to hit the target at its most vulnerable point with high precision. The various modes of operation allow the gunner to update or switch between targets after launch, avoid friendly fire, perform surveillance, damage assessment and attack hidden targets, or manually steer the missile towards the target. **Range:** 400-8,000m **Missile weight at launch:** 33kg (in canister) **Launcher weight:** 55kg **Missile length:** 1.67m **Missile diameter:** 170mm **Warhead type:** HEAT, fragmentation, PBF, PBF/F **Modes of operation:** fire-and-forget; fire, observe and update; fire and steer

Rafael Advanced Defense Systems ▸ Spike LR II



The Spike LR II is Rafael's fifth generation of the Spike missile and is backwards compatible with existing Spike launchers. Two warheads have been developed: a tandem HEAT warhead, which enhances armour penetration by more than 30%; and a new multipurpose blast warhead, which can be programmed by the gunner for impact or penetration detonation fusing. The warheads incorporate a new seeker that includes an uncooled IR sensor with a smart target tracker with AI features, and the ability to fire on grid target co-ordinates using an inertial measurement unit. The missile has a range of 10km launched from a helicopter. The Spike LR II weighs 12.7kg compared to 13.5kg for the Spike LR. The first deliveries of the missile are expected to take place by the Q4 2018. **Range:** 10km **Missile weight at launch:** 12.7kg **Warhead type:** tandem-HEAT warhead, multipurpose blast warhead **Launcher:** Spike Generic Launcher for 2 or 4 missiles

Rafael Advanced Defense Systems ▸ Spike NLOS



The Spike NLOS (non-line-of-sight) is a multi-purpose, EO missile system, with a real-time wireless data link able to attack targets at ranges of up to 25km. It can be installed on air, land and naval platforms. The missile entered the Israel Defense Force in the early 1980s. The Spike NLOS EO seeker incorporates a dual sensor capable of engaging targets during day and night, and in adverse weather conditions. The missile enables the defeat of long-range hidden targets with precision, damage assessment and the provision of real-time intelligence. The Spike NLOS is the primary weapon of the Republic of Korea Navy's new Leonardo AW159 Wildcat helicopters and also arms Colombian Army UH-60 Black Hawks. **Range:** 25km **Missile weight at launch:** 71kg **Modes of operation:** direct attack, mid-course navigation **Warhead type:** HEAT, fragmentation, PBF, PBF/F

Raytheon Missile Systems ▸ AGM-65 Maverick

The AGM-65 Maverick is an air-to-ground missile tactical missile designed for close air support and is part of a family of missiles designed to kill hardened/high-value targets, as well as moving/manoeuvring targets and ships/boats with minimal collateral damage. Developed from 1966, it entered service with the USAF in August 1972. It has since been exported to 30 nations worldwide and certified on 25 aircraft. **Max speed:** supersonic **Rate of fire:** can be ripple fired **Missile diameter:** 30.5cm **Propulsion:** 2-stage solid rocket motor **Warhead type:** basic 56.7kg shaped charge or 136.1kg kinetic energy penetrator/blast fragmentation **Guidance:** TV (AGM-65A/B); semi-active laser homing (AGM-65C/E); IR (AGM-65D/G); AGM-65F uses IR seeker with ship-recognition algorithms and larger warhead; AGM-65H/K has improved TV seeker with replacement CCD camera **Operating platforms:** AH-1W, AH-64A/D, SH-2G **Missile length:** 2.49m **Missile diameter open wingspan:** 71.9cm

Raytheon Missile Systems ▸ BGM-71 TOW

The BGM-71 Tube-launched, Optically tracked, Wire-guided (TOW) missile entered US Army service in 1970. The BGM-71 replaced smaller and technically inferior missile systems, enabling more power, range and the use of IR cameras for its greatly improved semi-automatic guidance system. The armour penetration against a vertical target for the original models was revealed to be between 430-630mm by a declassified CIA study. **Max speed:** high subsonic **Range:** 4km **Rate of fire:** engagement of one target must be completed before second missile is fired **Missile diameter open wingspan:** 45cm **Missile weight at launch:** 21.5kg **Propulsion:** solid rocket motor **Missile diameter:** 150mm **Guidance:** SACLOS, auto CLOS if sight has autotracker **Warhead type:** 6kg shaped charge; TOW 2A has precursor warhead on nose probe; TOW 2B has 2 downward firing warheads for top attacks **Operating platforms:** AH-1 series, AH-64 series, among others **Missile length:** 1.4m

Raytheon Missile Systems ▸ Griffin B

The Griffin A is an aft-eject missile designed for employment from non-conventional platforms such as the C-130. The Griffin B is a forward-firing missile that launches from rotary- and fixed-wing aircraft and ground applications. The user can select to guide the weapon precisely to the target using GPS co-ordinates, inertial navigation or laser designation, and can also select to engage the target with height of burst, point detonation or fuse delay. It is a powered missile with an estimated range of approximately 20km when fired from an aerial platform at altitude. The Block III adds an enhanced semi-active laser seeker, advanced electronics and signal processing, and a new Multi-Effects Warhead System that operates against multiple types of target. Confirmed platforms include the AT-6C turboprop, KC-130J Harvest Hawk, AC-130J Ghost Rider, MC-130W Combat Spear, MQ-1 Predator UAV, and the Cyclone Class patrol boat (see separate entries). Tests have been conducted on the OH-58D Kiowa Warrior (see separate entry). **Missile length:** 1.09m

Raytheon Missile Systems ▸ JAGM

A Raytheon-Boeing team previously competed to develop the Joint Air-to-Ground Missile (JAGM) to replace the Maverick, air-launched TOW and Hellfire in US service. The seeker integrated millimetre-wave radar and uncooled imaging IR sensors. In December 2012, US Army Aviation and Missile Command awarded the team a $65 million, 28-month two-phase contract to continue development. In 2013, however, the army decided not to execute the remainder of the contract for the TD phase. The Raytheon-Boeing team has now also decided to forego the scaled-down version of the competition in hopes of a follow-on tri-mode variant. **Length:** 1.79m **Width:** 180mm **Range:** >28km **Platforms:** UAVs, Apache helicopter

Roketsan ▸ Mızrak-U

Roketsan is developing the imaging IR-guided Mızrak-U, also known as the UMTAS (Long Range antitank System), and the laser-guided L-Mızrak-U (L-UMTAS) for the Turkish Army's new T129 ATAK helicopter. Initiated in 2005 and completed in 2015, the UMTAS is designed specifically to engage heavily armoured vehicles. The system has 'fire and forget' and IR guidance, and operates with a tandem warhead that can engage targets with reactive armour at eight kilometres. It locks-on before launch, can be used in all light and weather conditions and enables communication between the seeker image and command by user via data link. **Range:** 500-8,000m **Launcher weight:** 60kg **Missile weight at launch:** 37.5kg **Guidance:** inertial mid-course guidance before target engagement, autonomous guidance to the locked target, possibility to update target after lock-on **Operating platforms:** T129 ATAK **Missile length:** 1.8m **Warhead type:** tandem charge **Missile diameter:** 1.6m

Thales UK ▸ LMM

The Lightweight Multi-role Missile (LMM) is result of a rapid development programme that began in January 2007 to develop a missile capable of engaging a range of targets including static installations, vehicles (not MBTs), UAVs, light aircraft, helicopters, fast inshore attack craft and landing craft from a range of platforms, using a mix of technologies and off-the-shelf components. It will initially be offered with laser beam-riding guidance, but a semi-active laser homing variant will follow. Selected by the UK MoD for its Future Air-to-Surface Guided Weapon (Light) requirement, an initial order of 1,000 missiles and deliveries was placed for 2013 to enter service in 2015. **Max speed:** M=1.5 **Range:** 400-6,000/8,000m **Propulsion:** 2-stage solid-fuel rocket **Missile length:** 1.3m **Missile diameter open wingspan:** 26cm **Missile diameter:** 76mm **Warhead type:** shaped-charge and blast-fragmentation warheads will be offered, triggered by a laser proximity fuse

Anti-ship missiles ▸ Kongsberg Defence & Aerospace ▸ Penguin Mk 2 Mod 7 (AGM-119B)

The Norwegian AGM-119 ('Penguin') is a third-generation, all-digital ASM system, with a 360° open firing arc at all times and fully autonomous and passive during flight. Operator-selectable trajectories and flight profiles, accurate mid-course guidance, combined with high manoeuvrability, allow precise target approach. An IR seeker with target discrimination capability ensures target detection, validation, tracking and homing. Effective in open waters and the littoral, and resistant to countermeasures. It can be fired as a single shot or in coordinated-arrival salvoes. **Max speed:** high subsonic **Range:** 33km+ **Missile diameter open wingspan:** 1.4m deployed, 0.76m folded **Missile weight at launch:** 385kg **Propulsion:** 2-stage solid rocket motor **Missile diameter:** 28cm (fuselage) **Guidance:** Programmable inertial mid-course, passive IR terminal **Operating platforms:** SH-60B, S-70B, SH-2G, MH-60R **Warhead type:** 120kg semi-armour-piercing filled with 50kg HE **Missile length:** 3m

MBDA ▸ AS-15TT

The AS-15TT is a small, all-weather ('tous temps' in French) ASM capable of destroying small ships such as fast attack craft and disabling larger vessels. Developed as a replacement for the AS-12 missile, it has been operational on AS565 helicopters of the Royal Saudi Navy, which used it with success in Operation *Desert Storm*, and in the UAE. **Max speed:** 280m/s **Range:** >15km **Missile weight at launch:** 103kg **Missile diameter:** 180mm **Propulsion:** 2-stage (booster/sustainer) solid rocket motor **Guidance:** Agrion 15 radar on helicopter provides automatic CLOS guidance (tracks target and missile, sends steering commands to missile) **Operating platforms:** AS565, suitable for helicopters over 3.5t empty weight **Warhead type:** 30kg HE **Missile length:** 2.3m

MBDA ▸ Exocet AM39

The Exocet AM39 is an air-launched, fire-and-forget ASM. Developed from 1967 as a ship-launched weapon, the air-launched Exocet was developed in 1974 and entered service with the French Navy in 1979. It is guided inertially in mid-flight and turns on active radar late in its flight to locate the target. It flies one or two meters above the sea, as a countermeasure against its target's defences. The rocket motor is fuelled by solid propellant giving the Exocet a maximum range of 70km. In 2007, the system was updated to an enhanced Block 2 Mod 2 standard with a digitised autopilot and the same avionics as the latest MM40 ship-launched variants of the same missile. **Range:** 50-70km depending on launch altitude and speed **Missile weight at launch:** 670kg **Propulsion:** 2 solid propellant rockets (booster/sustainer) **Guidance:** Inertial navigation during cruise, active homing during terminal phase **Operating platforms:** various **Missile length:** 4.69m **Missile diameter:** 35cm

MBDA ▸ Marte Mk 2/S

The Marte Mk 2/S is a medium-range, fire-and-forget, all-weather, sea-skimming ASM system. It is a helicopter-launched horizon-range anti-ship weapon. The missile uses inertial mid-course navigation through waypoints and active-radar terminal homing in carrying out its attack. The fire control system comprises a MMCU (Marte Mission Control Unit) and a Mission Interface Unit. Belonging to the Marte Mk2 missile system family, it is designed to be used on fast jets and new-generation naval versions of European AW101 and NH90 helicopters (see separate entries) for operation against naval targets. . **Max speed:** high subsonic **Range:** >30km **Missile diameter:** 316mm **Missile weight at launch:** 324kg **Guidance:** inertial/GPS/altimeter/active radar **Operating platforms:** Italian Navy SH-3D; integration and qualification on AW101 and NH90 completed **Warhead type:** *semi-piercing HE fuses – impact and proximity* **Missile length:** 3.77m

MBDA ▸ Sea Skua

The Sea Skua is a British-made, all-weather, sea-skimming missile capable of destroying fast attack craft and disabling larger vessels. The British Aircraft Corporation began development of the Sea Skua in 1972 and it was procured by the British government in 1975. Primarily used by the RN on the Westland Lynx helicopter against ships, it has been deployed elsewhere in a shore battery and on fast attack craft. In March 2017, the RN conducted its final Sea Skua live-firing test. **Max speed:** high subsonic **Range:** >15km **Missile diameter open wingspan:** 72cm **Missile weight at launch:** 147kg **Propulsion:** 2-stage solid rocket motor **Missile diameter:** 25cm **Guidance:** semi-active radar homing – radar illuminates target, missile seeker homes onto reflected signal **Operating platforms:** Lynx, Super Lynx, Sea King and AB-212ASW; can be carried by Bell 214ST and 412, and Kaman Seasprite/Super Seasprite **Warhead type:** HE blast fragmentation, delayed-action fuse **Missile length:** 2.5m

MBDA ▸ Sea Venom/ANL

The Sea Venom/ANL (Anti-Navire Léger) is a helicopter-launched anti-surface missile designed to deal with the FIAC threat and vessels up to corvette size, as well as damaging larger vessels through aimpoint selection. Static land targets in the littoral also form part of the target set of this IR-seeker guided weapon. The system is being developed as an Anglo-French cooperative programme, with Sea Venom being the name chosen by the UK RN, while the weapon is designated ANL by France. The missile was first launched from a helicopter on 21 June 2017. It is expected to enter RN service in 2020. **Applications:** anti-surface, maritime and littoral land target **Max speed:** high-subsonic **Range:** 20km **Operating platforms:** AW159 Lynx Wildcat, Panther, NH90 **Missile weight at launch:** 110kg + 30kg warhead **Missile length:** 2.5m **Missile diameter:** 0.2m

Tactical Missiles Corporation ▸ Kh-35

The Zvezda ('Star') Kh-35 is a long-range, radar-guided ASM in the same class as Exocet. Development on the Kh-35 began in 1985 when the Soviet Union aimed to acquire armaments for ships of medium tonnage. The jet-launched version of the subsonic cruise anti-ship missile, designated the X-35Y in Russia and AS-20 Kayak by NATO, can be launched from helicopters or coastal batteries with the help of a rocket booster. Nicknamed 'Harpoonski' due to its likeness to the US Harpoon anti-ship missile system, it is designed to attack vessels up to 5,000t. **Max speed:** 300m/s **Range:** 130km **Propulsion:** solid rocket boost motor and turbojet sustainer **Missile diameter:** 42cm **Guidance:** inertial and active radar homing **Operating platforms:** Ka-27/28 **Warhead type:** 145kg blast fragmentation **Missile length:** 3.75m **Missile diameter open wingspan:** 93cm

Guns, pods, turrets ▸ BAE Systems ▸ RGS (AWG-35)

The RGS (AWG-35) fulfils the USMC requirement for an Interim Defensive Weapon System for the MV-22 tiltrotor. Armed with a three-barrel 7.62mm GAU-7 minigun, the Remote Guardian System (RGS) is located in the V-22 cabin area and mounted inside the cabin. The system retracts within the aircraft's structure when not employed. The RGS provides 360° coverage and is delivered as a mission kit that can be removed when not in use. The system is mission configurable, crew-served and night vision device compatible. It is operated remotely by a non-pilot crew member. In March 2012, BAE Systems received a $31 million modification to a delivery order to design and develop improvements to the IDWS turret and retrofit in-service systems. **Applications:** suppressive fire in landing zones and against troops and light armoured vehicles **Calibre:** 7.62mm **Operating platforms:** V-22 aircraft

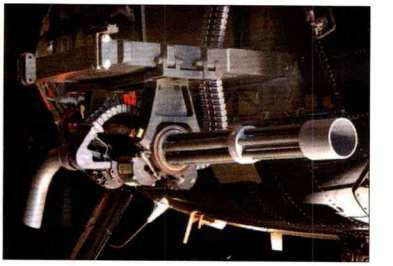
Denel Land Systems ▸ Vektor GA1 20mm Automatic Cannon

The 20mm GA1 cannon is an improved version of the German 20mm MG 151 automatic cannon. The system is suitable to be installed on aircraft, helicopters, light vehicles and armoured fighting vehicles. It has a low recoil force, making it suitable for installation on handheld or automatic mountings. It can be adapted for left or right-hand feed and fires from the open-bolt position. The GA1 cannon can be converted to a 2.7mm machine gun by adding a feed plate and a barrel jacket and changing the barrel and bolt assembly. The gun is currently in service with the South African National Defence Forces. **Length:** 1.47m **Power:** 22-29V DC **Weight:** 39kg **Calibre:** 20mm **Rate of fire:** 650-750 rounds/min **Ammunition:** PRAC and PRACT, HEI, HEIT, SAPHEI, APC **Recoil force:** 3,500N (average) **Muzzle velocity:** 720m/s **Sights:** Armson 'occluded eye' red-dot gunsight or Gennet optical sight **Operating platforms:** tested on Denel Rooivalk and Puma

Dillon Aero ▸ M134D

The Dillion M34D is a six-barrelled, electrically driven 7.62mm Gatling gun that fires at a fixed rate of 3,000rounds/min. The standard application for the gun is helicopter crew-served and/or in a fixed forward-fire installation. The weapon is typically fed from a 3,000- or 4,000-round magazine and sold as a complete weapon system or as a component upgrade package for older GE M134 systems. The mounting options include door and forward-firing fixed mounts for various helicopters including the Bel UH-1 series, Being CH-47 and Sikorsky UH-60 series. The new BAE RGS, designed for use on the Bell-Boeing V-22 Osprey, is armed with the M134D. **Weight:** 25.8kg fixed forward-fire, 30kg crew-served **Rate of fire:** fixed 3,000 or 4,000rpm

Dillon Aero ▸ M134DT

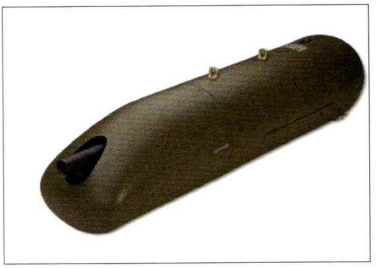


The M134DT is Dillon's titanium Gatling gun for weight-critical applications. In a complete redesign of the standard steel M134D, skeletonised components and titanium were combined to reduce the gun's weight by nearly 20%, or about 5-7kg per gun. Titanium components include the rotor, housing, DAFD-2001 feeder/delinker and barrel clamp/flash suppressor. The gun retains the features of the M134D, such as the six-barrel design and electrically driven 7.62mm Gatling gun. To maximise weight-saving, the system utilises Dillion Aero's new lightweight rotor, which has replaceable locking lugs to extend its service life. **Weight:** 18.8kg fixed forward-fire, 22.9kg crew-served **Rate of fire:** fixed 3,000 or 4,000prm **Operating platforms:** door and forward-firing fixed mounts for various helicopters including Bell UH-1 series, Boeing CH-47 and Sikorsky UH-60 series

Dillon Aero ▸ M134D Minigun Pod

Dillon unveiled a prototype of its M134D Minigun Pod designed for use on helicopter and light fixed-wing aircraft in June 2012. The pod is armed with Dillon's 7.62mm M134D-H Titanium Hybrid Gun and 3,000 rounds. The system is mounted on a 14in NATO rack. The M134D-H is the latest Gatling gun from Dillon. The gun combines the lightweight attributes of the M134D-T weapon with the durability of the M134D steel variant. Engineering development continued through 2013, with first delivery of the systems taking place in 2014. **Length:** 184cm **Width:** 38cm **Weight:** 190kg **Ammunition:** 3,000 rounds **Operating platforms:** (upon delivery of production systems) helicopters and light fixed-wing aircraft

FN Herstal ▸ FN HMP



FN Herstal's Machine Gun Pod (FN HMP) is axially mounted on a carrier and operated by the pilot in the cockpit. It is a self-contained system and presents an all-in-one concept which offers a .50cal FN M3P machine gun, 250- or 400-round ammunition box, firing actuator and cocking device in one casing, which allows for use in sandy or dusty conditions. The FN M3P machine gun has a flash hider and is installed on a soft mount that absorbs most recoil forces for increased accuracy. **Length:** 181cm (HMP 250); 194cm (HMP 400) **Height:** 41cm (HMP 250); 43cm (HMP 400) **Weight:** 118.5kg (HMP 250); 140kg (HMP 400) **Range:** 2,500m **Calibre:** .50cal (12.7x99mm NATO) **Rate of fire:** 1,100rounds/min **Ammunition:** ball, tracer, armour-piercing, armour-piercing incendiary, armour-piercing explosive incendiary; 250- or 400-round ammunition box **Operating platforms:** numerous rotary- and fixed-wing aircraft types **Modes of fire:** 1,100rounds/min

FN Herstal ▸ FN M3M (GAU-21) on Pintle

The FN M3M pintle-mounted systems are designed for multirole vehicles and integrate either a 7.62x51mm NATO FN MAG 58M or a .50cal FN M2HB-QCB or a FN M3M (GAU-21) machine gun. The FN M3M Pintle weapon system includes: a .50cal FN M3M (GAU-21) machine gun with spade grips; a medium pintle head including a soft mount; a feeding kit, including 600 round ammo box and feed chute; an operational links collector; and an operational day and night vision device. It also has open-bolt firing to avoid cook-off problems, wide angle of operation and long burst capability, firing 600 rounds in one burst. The system is designed for missions such as suppressive fire against light armoured vehicles, threat suppression and training. **Weight:** 35.8kg **Range:** 2,500m **Calibre:** .50cal **Rate of fire:** 1,100rounds/min **Ammunition:** ball, tracer, armour piercing, armour-piercing incendiary, APEI fired from 300- or 600-round boxes **Operating platforms:** numerous helicopter types **Modes of fire:** open-bolt

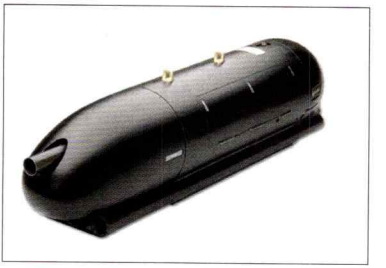
FN Herstal ▸ FN M3P Machine Gun

The FN M3P is a .50cal single-barrel high rate of fire, fully automatic machine gun. It was designed, developed and manufactured by FN Herstal to be axially or coaxially mounted in pod or open-air configurations in rotary- and fixed-wing aircraft. It is capable of providing both offensive and defensive firepower ranging out to nearly 1,850m and is designed to provide high firepower and firing rates while being easy to maintain. It is operated in open bolt to prevent any cook-off problems and has firing solenoid and guided blast flash hider (NVG compatibility). The FN M3P can fire a range of .50cal cartridges (ball, tracer, API and APEI) and is available with either left or right-hand-side feeding. Other features of the weapon system include the 28V electrical interfaces that enable remote firing and clearing of the weapon system, as well as enabling the operator to remotely place the weapon on safe. **Weight:** 37kg **Range:** 2,500m **Calibre:** .50cal (12.7x99mm NATO) **Rate of fire:** 1,025±75rounds/min

FN Herstal ▸ FN MAG 58M Machine Gun

The FN MAG 58M machine gun is a single-barrel, fully automatic 7.62x51mm NATO machine gun designed to be pintle-mounted on FN Herstal's mounts in rotary-wing aircraft. The FN MAG 58M is a variant of the infantry FN MAG general-purpose machine gun, originally designed, developed and manufactured by FN Herstal, and in service under many different names (eg M240, L7A2, C6, Ksp58). It provides high volumes of sustained fire, operates from an open-bolt mode (this ensures no cook-off problems), and includes quick-change barrel combined with wide angle of operation. The FN MAG 58M comes with spade grips as standard for improved firing control. The FN MAG 58M is the key component of FN airborne pintle-mounted systems that can be window-, door-, ramp- or externally positioned. It is deployed worldwide. **Weight:** 12.7kg **Range:** 1,000m **Calibre:** 7.62x51mm NATO **Rate of fire:** 650-1,000rounds/min (adjustable) **Modes of fire:** open-bolt

FN Herstal ▸ FN RMP

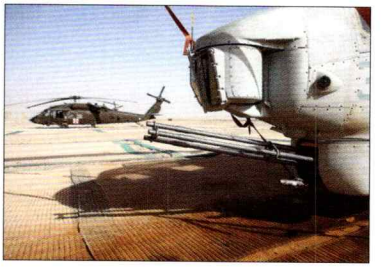


FN Herstal has designed and manufactured the Rocket Machine Gun Pod (FN RMP), a self-contained, all-in-one weapon system. The system includes a .50cal FN M3P machine gun, 250-round ammunition box, three-tube 2.75in rocket launcher, firing actuator and cocking device in one casing, allowing for continued performance rates in sandy or dusty conditions. The system has a fit-and-plug concept through 14in NATO standard lugs for quick adjustment of the helicopter configuration, depending on the mission requirements. The pilot has the ability to switch immediately from .50cal firing to 2.75in rocket firing. **Length:** 194cm **Height:** 43.4cm **Weight:** 160kg fully loaded **Calibre:** .50cal (12.7x99mm NATO) machine gun; 2.75in (70mm) rockets (guided or unguided) **Rate of fire:** 1,100rounds/min **Ammunition:** ball, tracer, armour-piercing, armour-piercing incendiary, APEI machine gun, full range of 2.75in rockets **Operating platforms:** numerous rotary- and fixed-wing aircraft types

General Dynamics Ordnance and Tactical Systems ▸ GAU-19/A

The GAU-19/A is a 12.7mm, three-barrel, externally mounted Gatling Gun produced by General Dynamics Ordnance and Tactical Systems to provide high-rate-of-fire firepower in a small, lightweight weapon system. The weapon is effective in both air-to-air and air-to-ground missions. The gun is installed within a fixed-forward mount that can be attached to standard 14-inch NATO stores racks or lightweight mount, which attaches directly to a universal stores pylon. **Length:** 1.18m overall **Power:** externally powered **Weight:** 63kg with feeder and transfer unit **Range:** 1,800m **Calibre:** .50cal **Rate of fire:** selectable, 1,000-2,000rounds/min **Ammunition:** M1, M8 API, M17 tracer, M20 APIT, M33 ball, M903 SLAP and M948 SLAP tracer **Recoil force:** 2.24kN **Reliability rounds between predicted failures:** 100,000 mean rounds **Scheduled maintenance intervals:** 15,000 rounds **Dispersion:** 80% of rounds within 5μrad of pointing axis

General Dynamics Ordnance and Tactical Systems ▸ M197



The M-197, produced by General Dynamics Ordnance and Tactical Systems is a lightweight, three-barrel, 20mm, version of the M61A1 Gatling Gun. The lightweight gun is capable of firing up to 1,500 shots per minute. The gun is specifically designed for helicopters, light fixed-wing aircraft and small naval attack vessels. It is adaptable for turret, pod and pintle or internal installations using either linked or linkless ammunition feed systems. Currently the M-197 arms the Marine Corps Ah-1J, AH-1T, AH1W and AH-1Z. The M-197 is also used in the GPU-2/A 20mm gun pod. The system utilises a continuous rotary motion to reduce its power requirements. **Length:** 1.89m **Power:** externally powered **Weight:** 66kg **Calibre:** 20mm **Rate of fire:** up to 1,500 rounds/min **Ammunition:** M50 series and PGU-28B **Muzzle velocity:** 1,030m/s **Operating platforms:** AH-1 **Recoil load:** 68kg (average at 1,500rounds/min)

KBP Instrument Design Bureau ▸ 2A42

The 2A42 is a 30mm automatic cannon that arms the Mi-28N attack helicopter and is mounted on a steerable chin turret. It is also mounted on the Ka-50/52 series on the right side of the fuselage below the cockpit and can be depressed to engage targets below the helicopter's flight path. The system has a dual feed, one for high explosive incendiary ammunition and the other for armour-piercing shell. The gunner is able to select one of two rates of full automatic fire, low at 200-300rounds/min. The effective range of the system when engaging ground targets is such as light armoured vehicles is 1,500m while soft-skinned targets can be engaged at 4,000m. Air targets can be engaged flying at low altitudes of up to 2,000m and up to a slant range of 2,500m. **Calibre:** 30mm **Range:** 1,500-4,000m **Rate of fire:** 550-800 rounds/min (high), 200-300 rounds/min (low) **Muzzle velocity:** 960m/s **Operating platforms:** Mi-28N attack, Ka-50/52 series

KBP Instrument Design Bureau ▸ YAK-B

The YAK-B is a four-barrel 12.7x108mm Gatling gun. The system is remotely controlled, using a gas-operated mechanism and offers a high rate of fire. It can be mounted in an USPU-24 turret on Mi-24 series attack helicopters which provides an azimuth of 60° to either side, an elevation of 20° and a depression of 60°. It can also be mounted in a GUV pod for pylon mounting. The model was replaced by the fixed, chin-mounted GSh-30K or the smaller GSh-23L in the late mark of the Mi-24 helicopters. **Weight:** 45kg **Calibre:** 12.7x108mm **Rate of fire:** 4,000-4,500rounds/min **Muzzle velocity:** 810m/s **Operating platforms:** Mi-24 and other Russian combat helicopters

Nexter Systems ▸ 20 M621 Cannon

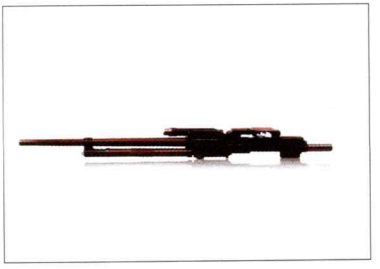
The 20 M621 20mm cannon can be mounted on 19A cabin pintles for use in medium helicopters. It has been pod-mount qualified on AS565, AS555, AS532, S-76, Bell 406, UH-60. Type 22A and Type 23A flexible cradle co-axial mounts are available for SA 342 and AS555 respectively. The THL20 gun turret system can be used on attack and transport helicopters. The latest development of the cannon is the retractable SH20, which was designed for special forces operations and was integrated on French Army H225Ms in 2006. **Length:** 2.18m **Width:** 203mm **Height:** 194mm **Power:** 28V, 10A **Weight:** 49kg (gun) **Calibre:** 20mm **Rate of fire:** 750rounds/min (+/-100) **Ammunition:** 20x102mm **Recoil load:** max 250daN **Operating platforms:** AS565, AS555, AS532, S-76, Bell 406, UH-60, SA342, AS555, H225M **Modes of fire:** single-shot, limited or unlimited bursts

Nexter Systems ▸ 30 M781

The 30 M781 arms the French Army's Gerfaut combat support version of the Airbus Helicopters Tiger. It is mounted in a powered turret slaved to a helmet sight, HUD or roof-mounted sight. The system has considerable recoil, meaning that it is typically used for single shots or controlled bursts rather than continuous fire. It is currently used on the Eurocopter Tiger and is also offered for naval use as part of the NARWHAL system. Ammunition options include HE incendiary, armour-piercing, armour-piercing shell and target practice. **Length:** 1.87m **Weight:** 56kg (gun), 160kg (gun and turret) **Range:** 0-1,500m **Calibre:** 30mm **Rate of fire:** up to 750 rounds/min **Ammunition:** 30-550 type **Recoil load:** 800daN max **Muzzle velocity:** 730m/s **Operating platforms:** Tiger **Modes of fire:** single round, ten-round bursts, 25-round bursts, continuous

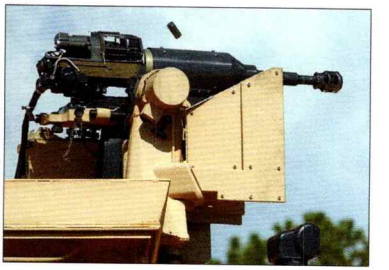
Norinco ▸ W99

The W99 12.7mm aircraft machine gun is designed for use in helicopter weapon pods. The gun can be used with a range of ammunition types, including armour-piercing, incendiary tracer and armour-piercing HE ammunition. The W99 is capable of firing at a rate of 500-700rounds/min at a range of 1,600m. **Length:** 1.44m **Weight:** 23kg **Range:** 1,600m **Calibre:** 12.7x108mm **Rate of fire:** 500-700rounds/min **Ammunition:** armour-piercing incendiary tracer, armour-piercing HE



Orbital ATK Armament Systems ▸ LW25 Bushmaster Chain Gun

The LW25 is a 25mm gun based on Orbital ATK's Bushmaster family and is a derivative of the combat-proven M242 25mm Bushmaster Automatic Cannon. The design has a dual feed with first round select and scalable lethality from non-lethal to airburst, remote or manned operation. The gun can be soft mounted to reduce recoil and includes a two-sided muzzle brake developed and tested for aircraft applications. The system has been successfully fired from the Boeing Unmanned Light Attack Recon and has been integrated into a range of land platforms **Length:** 1.17m **Power:** 28V DC **Weight:** 30.8kg **Calibre:** 25mm **Rate of fire:** 250rounds/min **Reliability rounds between predicted failures:** >35,000

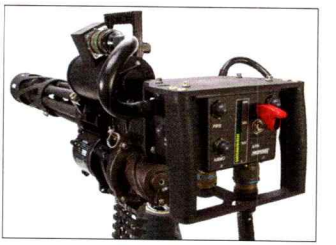


Orbital ATK Armament Systems ▸ LW30 M230 Automatic Cannon

The LW30 M230 is a chain-driven, single-barrel, externally powered weapon for attack helicopters effective against lightly armoured vehicles and aircraft. The system uses a 2hp electric motor to load 30mm linkless ammunition at a rate of 625rounds/min. It also has a positive cook-off safety for open-bolt clearing and double-ram prevention. The M230 is the only gun system used on the Boeing AH-64 series, where it is mounted in a powered turret with up to 1,200 rounds of ammunition. The US also uses the M230 on MH-60L Direct Action Penetrator helicopters. **Length:** 1.68m **Power:** 2hp, externally powered **Weight:** 57.5kg **Range:** up to 4,000m **Calibre:** 30mm **Rate of fire:** 625rounds/min **Ammunition:** NATO standard Aden/DEFA rounds plus US M788 Target Practice, M789 High Explosive Dual Purpose and M799 High Explosive **Operating platforms:** AH-64 **Modes of fire:** single rounds, limited, unlimited bursts

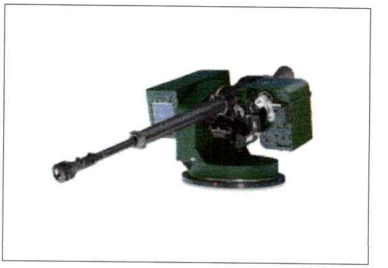
Profense ▸ Profense M134

The Profense M134 Gatling Gun is an electrically driven, automatic machine gun with a sustained rate of fire in excess of 3,000rounds/min. The M134 fires the standard 7.62x51mm NATO cartridge and utilises M13 Link ammunition. The M134 can either be battery powered or powered from the platform's electrical system. The patented 'Aeroclamp' acts as a standard flash suppressor, and also functions by design to help draw air in and direct it around the barrels as they spin, which assists in cooling. The system also has a single-tang bolt assembly to reduce operational readiness inspections, and a multi-functional gun control unit for ammunition status. The Profense M134 is in service with several international customers in use on various types of boats, helicopters and vehicles. **Length:** 80.2cm **Width:** 30.5cm **Power:** 18-33 VDC, 58 continuous amps **Weight:** 25-30kg **Rate of fire:** 3000-4000rounds/min **Ammunition:** NATO 7.62 x 51mm **Recoil load:** 91-136kg

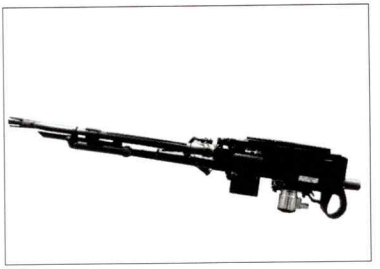


Rheinmetall Waffe Munition ▸ RMK 30

The RMK 30 is a recoilless, single-barrel, 30mm revolver cannon developed by Mauser, a subsidiary of the Rheinmetall group. The development of the gun began in 1993 in response to the German Bundesamt für Wehrtechnik und Beschaffung requirements for a new recoilless autocannon. A turret has been designed to mount the weapon on German UHT Tiger and other helicopters. The system operates via a proportion of the propellant gas exhausts through a nozzle at the rear of breech to provide thrust to counter recoil and a muzzle brake is also fitted to the gun. It is a three-chamber revolver cannon which utilises an electric motor that enables variable rates of fires of up to 300rounds/min. The gun uses combustible-case ammunition and is capable of firing salvos or in fully automatic mode without producing recoil. **Length:** 1.7m **Weight:** 100kg **Calibre:** 30x250mm **Muzzle velocity:** 1,200m/s **Operating platforms:** intended for German UHT Tiger and other helicopters, turret mount designed



S&T Motiv ▸ K12

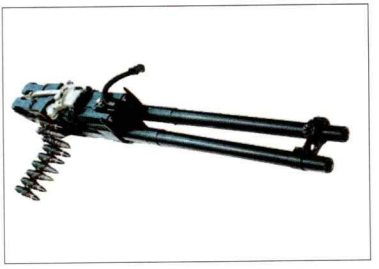


The K12 7.62mm is a machine gun developed by S&T Motiv for use as a pintle-mounted weapon on the Republic of Korea Army's new KAI KUH-1 Surion utility helicopter. The K12 design is based on the K3's design, layout and function, using a gas piston and rotating bolt. It is fed through a STANAG M13 disintegrating belt link. The cross-bolt type safety is the same as the K3, with a receiver made from steel press with an aluminium alloy feed cover. The gun also has a pistol grip, spade grip and metal sliding stock all in one gun to facilitate conversion into a ground-rife machine gun by a dismounted operator. In 2012, the K12 light machine gun was adopted as the standard armament of the KUH helicopter and is currently only in use with the 300 planned helicopters. **Weight:** 11.9kg **Calibre:** 7.62x51mm **Rate of fire:** 650-950rounds/min **Operating platforms:** KUH-1 **Modes of fire:** automatic

US Ordnance ▸ M60D Enhanced

The 7.62mm M60D Enhanced is a version of the standard M60E4/MK 43, designed to be used as a pintle-mounted door gun in helicopters. The M60D Enhanced has a redesigned machined aluminium feed cover with integrated M1913 Picatinny rail for other sensors, giving the weapon 24h capability. It is a gas operated, disintegrating link, belt-fed, air-cooled machine gun which fires from an open bolt and has a quick-change Stellite-lined barrel. The machine gun is fitted with spade grips for flexible use and an aircraft ring sight for rapid target acquisition. Customers of the gun include Columbia, Mexico, the Philippines, Spain, the UK (early variant) and the US. **Length:** 1.11m **Width:** 146mm **Weight:** 11.03kg **Range:** 3,725m max, 1,100m max effective **Calibre:** 7.62x51mm **Rate of fire:** 500-600rounds/min **Muzzle velocity:** 853m/s **Operating platforms:** UH-1, the CH-47 in both door and ramp locations, UH-60

V. A. Degtyarev Plant ▸ GSh-23L



The GSh-23 is a 23mm double-barrelled aircraft gun designed by KBP Instrument Design Bureau. The gun is designed to fire fragmentation mines, armour-piercing explosives and armour-piercing tracer shells from different types of aircrafts and helicopters at air and ground targets. The gun can be used on the right or left feed and can be installed on Tu, MiG, Su and Yak aircrafts and Mi and Ka helicopters. The gun is produced in two modifications – the GSh-23L and the GSh-23. **Length:** 1.54m with muzzle brake, 1.39m without **Width:** 165mm **Height:** 168mm **Power:** electric, 27V **Weight:** 50kg **Calibre:** 23x115mm **Rate of fire:** 3,000 or 3,400rounds/min **Ammunition:** 4,000-round capacity **Muzzle velocity:** 700m/s **Operating platforms:** various Russian helicopters and others

V. A. Degtyarev Plant ▸ GSh-30K

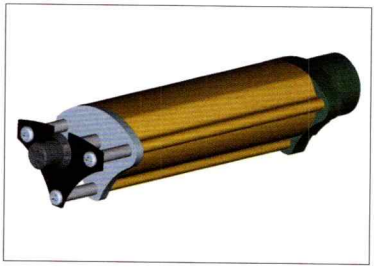
The 30mm GSh-30K was designed by the KBP Instrument Design Bureau and is manufactured by VA Degtyarev. It is a water-cooled, 2400mm twin-barrelled, medium-velocity, gas-operated automatic cannon intended for use on helicopters and fixed-wing attack aircraft, in particular the Mi-24P helicopter. The gun is designed for firing at air and ground targets with HE, armour-piercing explosives and armour-piercing tracer shells. A GSh-30 version of the gun is also available with 1500mm barrels. It is mounted on aircraft such as the SU-25. **Calibre:** 30x164m type AO-18 **Rate of fire:** variable, probably 1,500-1,800rounds/min **Muzzle velocity:** 1,020m/s **Operating platforms:** Mi-24 family, in pods on Russian combat helicopters

V. A. Degtyarev Plant ▸ Kord

The Kord 12.7mm HMG first entered service in 1998 to replace the 12.7mm NSV HMG. It can be used in various roles, including dismounted infantry, pintle-mounted on AFVs, and helicopter- and boat-mounted. The Kord can be fired from a bipod and incorporates numerous improvements over the early NSV. The Kord is designed to use either 12.7x108mm Soviet/Russian or .50 BMG (12.7x99mm) NATO ammunition by changing the barrel and feed mechanism. The gun is designed to deal with light-armoured targets and weapons and enemy personnel at ranges of up to 1500-2000m, and against air targets at slant distances of 1500m. **Range:** 2,000m **Calibre:** 12.7x108mm **Rate of fire:** 600rounds/min **Technical endurance:** 10,000 rounds **Muzzle velocity:** 820-860m/s Barrel **weight:** 9.25kg Loaded magazine **weight:** 11.1kg Loaded belt **weight:** 7.7kg for 50-round belt **Armour piercing capability at a specific range:** up to 20mm at 100m

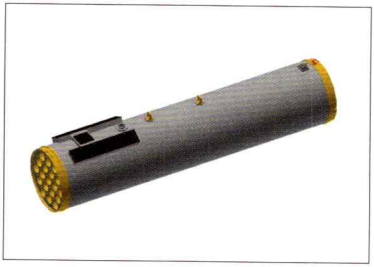
Launchers ▸ Arnold Defense ▸ Intervalomater

This device allows pilots to select and fire individual rocket tubes in sequential order, or ripple-fire an entire launcher within seconds. The ten-round and 19-round intervalometers provide a 40ms and 60ms space in between rocket fires, respectively. Roughly the size of a small handheld flashlight, the intervalometer fits inside launchers such as the LAU-68 or LAU-131 and is set by ordnance technicians prior to take-off.



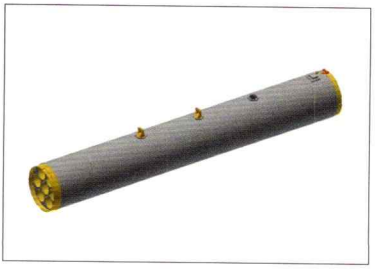
Arnold Defense ▸ LAU-61 G/A

The LAU-61 G/A is a digital rocket launcher that carries 19 2.75in rockets, and has two mounting lugs and a 1760 connector. It is being used aboard USN MH-60 R/S helicopters specifically for use with BAE's Advanced Precision Kill Weapon System (APKWS-II). In late 2015, the USN awarded Arnold Defense a $19 million contract for more LAU-61 G/A launchers, as well as LAU-68s, LAU-131s and associated electronic components. The LAU-68 G/A is available internationally only through USN FMS. **Empty weight** 92.99kg **Length:** 194.4cm **Diameter:** 41.32cm



Arnold Defense ▸ LAU-68 F/A

The LAU-68 F/A is an extended length rocket launcher that carries seven 2.75in guided rockets. It has two mounting lugs and one 5-pin connector, and uses a built-in intervalometer. This launcher is thermal coated for shipboard use. The LAU-68 is available internationally only through USN FMS **Empty weight** 92.99kg **Length:** 194.4cm **Diameter:** 41.32cm



Arnold Defense ▸ LAU-131 A/AA

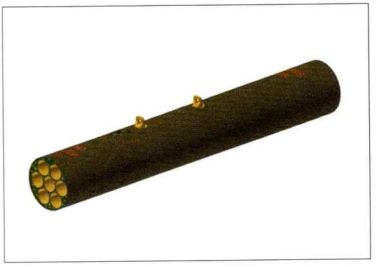
The LAU-131 A rocket launcher carries seven 2.75in rockets. It has two mounting lugs and two 5-pin connectors, and uses a built-in intervalometer. The LAU-131 A/A is an extended variant to accommodate guided rockets and is nearly one foot longer. The LAU-130 (regular A or extended length AA) is the 19-round version of this launcher, which is also available for production. **Empty weight** 29.5kg (A); 34.02kg (AA) **Length:** 152cm (A); 180.6cm (AA) **Diameter:** 25.7cm (A/AA)

Arnold Defense ▸ LWL-12-A

The LWL-12 is a newly designed lightweight rocket launcher that carries 12 2.75in rockets. It is designed for rugged use aboard special operations helicopters or those with limited ground clearance as it can carry 60% more ordnance than an M260 (see separate entry). It has two mounting lugs, a 23-pin fusing connector and a 26-pin firing connector. An extended length variant is also available for guided rockets. **Operating platforms:** special operations helicopters **Empty weight** 28.6kg **Length:** 167.94cm **Diameter:** 40.1cm

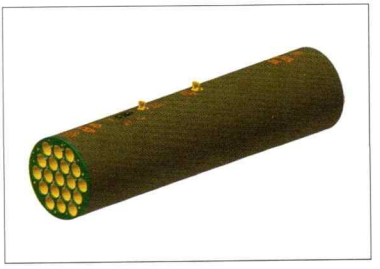
Arnold Defense ▸ M260

The M260 lightweight rocket launcher carries seven 2.75in rockets and is for use aboard attack helicopters such as the AH-64, OH-58, AH-1, Bell 407 AH and many others. It has two mounting lugs, a 23-pin fusing connector and a 26-pin firing connector. **Operating platforms:** attack helicopters **Empty weight** 15.9kg **Length:** 168.15 cm **Diameter:** 24.68cm



Arnold Defense ▸ M261

The M261 lightweight rocket launcher carries 19 2.75in rockets and is for use aboard larger attack helicopters such as the AH-64D, AH-1Z and many others. It has two mounting lugs, a 23-pin fusing connector and a 26-pin firing connector. **Operating platforms:** large attack helicopters **Empty weight** 39.5kg **Length:** 168.15cm **Diameter:** 40.32cm

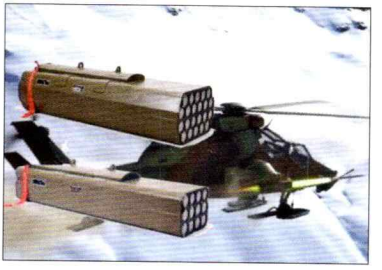


TDA Armements ▸ TELSON 8

The TELSON 8 tube rocket launcher is designed for use on light helicopters deployed on reconnaissance or liaison missions. It can deliver both non-guided and Induction Laser Guided Rockets. This addition to the TDA's family of digital induction rocket systems offers retrofit opportunities on older-generation light helicopters. **Operating platforms:** light helicopters **Empty weight** 30kg **Multi-darts rockets:** 90kg **Maximum mass:** 101kg

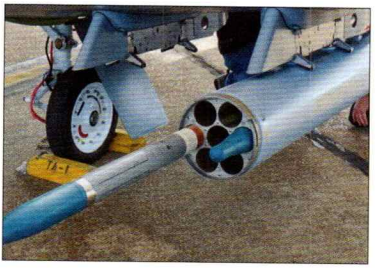
TDA Armements ▸ TELSON 12/TELSON 22

The TELSON 12 tube and TELSON 22 tube rocket launchers belong to TDA's family of digital induction rocket systems and are designed for use on 'all types of combat helicopters in service', according to TDA. The modular approach provides the possibility of mixing guided and non-guided rockets, rockets and air-to-ground missiles, rockets and air-to-air missiles, or the three kinds of munitions together. **Operating platforms:** All combat helicopter platform types **Empty weight** 43kg (TELSON 12); 65kg (TELSON 22) **Multi-darts rockets:** 133kg (TELSON 12); 230kg (TELSON 22) **Maximum mass:** 149kg (TELSON 12); 259kg (TELSON 22)



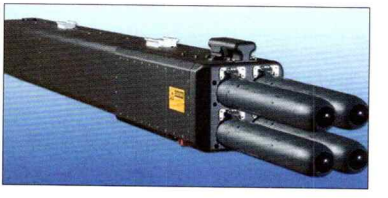
Rockets (guided) ▸ BAE Systems ▸ APKWS II

In April 2006, BAE Systems was selected by the USN for the Advanced Precision Kill Weapon System (APKWS) II project to provide a semi-active laser guidance and control system for attachment to Hydra 70 rockets in the US inventory. Due to its mid-body, power-up-after-launch design, APKWS II can be modified from any existing 70mm rocket and fired from current and future launchers with no aircraft modifications. The APKWS II has been demonstrated on more than 12 rotary- and fixed-wing aircraft. On 12 June 2017, BAE Systems announced that it had received a $180.5 million delivery order. **Weight:** 15.9kg **Max speed:** supersonic **Range:** 1.5-5.5km **Guidance:** WGU-59/B is a distributed-aperture, semi-active laser-guidance capability implemented in a screw-in module between motor and warhead with four 10mm diameter laser seekers giving it a 40° FOV and a 28° FOV **Operating platforms:** AH-1W, AH-1Z, MH-60S, MH-60R



Lockheed Martin Missiles and Fire Control ▸ DAGR

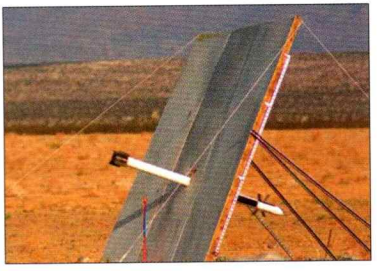
The DAGR is a 70mm precision-strike, multirole, multi-platform missile designed to neutralise non-armoured and high-value targets close to civilian assets or friendly forces. The DAGR system puts Hellfire II missile and joint air-to-ground missile technology in a 70mm guidance section that integrates with legacy hydra-70 rockets. By doing this, Lockheed Martin have produced a laser-guided missile that offers capabilities beyond those of a simple guided rocket. **Length:** 1.9m **Wingspan:** 222mm **Range:** 12,000m when launched 20,000ft, 1,500-6,000m from sea level **Guidance:** semi-active laser **Operating platforms:** AH-64, OH-58, AH-1, MH-6, Tiger **Warhead type:** M151 with M323 fuse



Magellan Aerospace ▸ CRV7-PG

The CRC7 Rocket Weapon System by Magellan is a 70mm unguided rocket system that has been sold to 13 countries around the world. The system has rocket motors, launchers and warheads of various models depending on mission objectives. The rocket's spin rate is generated by the vanes in the rocket motor nozzle initially and then by specially designed wrap-around fins during rocket flight and has been tested on the Apache helicopter. **Weight:** 6kg **Max speed:** M=3+ **Range:** 6km+ **Launcher:** Hydra 70 detent launchers (19-tube M261 and 7-tube M260) **Operating platforms:** WAH-64, AH-64D, Rooivalk, Super Lynx, UH-1H, OH-58 **Propulsion rocket motor:** reduced-smoke, composite solid propellant **Warhead type:** HE, armour-piercing, flechette, flare and training

MBDA ▸ Laser Guided Zuni

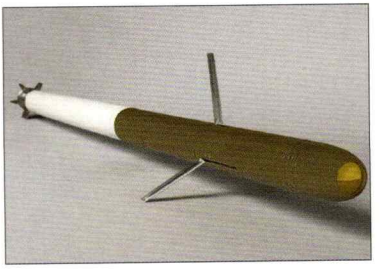


The Laser Guided Zuni has an 18kg warhead that is deployable against both fixed and moving targets. It is designed to attack fixed and fleeting targets that require a high-speed, precise, low-collateral-damage weapon for current and future conflicts. The Laser Guided Zuni rocket WGU-58/B active guidance and control system attaches to existing unguided 127mm Zuni rocket motors and warheads in the field. The aircraft interface remains the same for the Laser Guided Zuni Rocket, permitting rapid transition to precise attack. Existing LAU-10 launchers each carry four of the Laser Guided Zuni Rockets. According to the company, aircraft equipped with the Laser Guided Zuni are able to engage two to four times the targets than other available laser guided weapons. **Length:** 2.8m **Weight:** 150kg, warhead 18kg **Max speed:** >M=2 **Warhead type:** blast fragmentation, thermobaric

Orbital ATK Armament Systems ▸ GATR

The Guided Advanced Tactical Rocket (GATR) is a 70mm precision system which uses a semi-active laser guidance package to achieve accuracy against both stationary and moving targets. GATR provides pilots with the capability to lock-on before launch to ensure that only the target of interest is engaged, providing precision strike designed to reduce collateral damage at a lower cost than current guided missiles. GATR supports integration on all fixed- and rotary-wing platforms and is compatible with existing 70mm rocket launcher hardware. **Applications:** air-to-ground and ground-to-ground missions against soft, lightly armoured, stationary, moving and manoeuvring targets **Length:** 1.8m **Weight:** 14.9kg **Range:** 1km-8/15km (rotary wing/fixed wing) **Launcher:** compatible with existing 2.75in rocket launchers **Operating platforms:** fixed- and rotary-wing platforms **Warhead type:** multiple **Guidance:** SAL

Raytheon Missile Systems ▸ Talon LGR



Raytheon, in partnership with Emirates Advanced Investments Group, developed the Talon Laser-Guided Rocket (LGR), a semi-active laser guidance and control kit that connects directly to the front of 70mm unguided rockets. The weapon integrates Raytheon's digital semi-active laser technology to develop an easily deployed, low-cost and high-precision weapon for missions in urban environments, counterinsurgency and swarming boat defence. The Talon system is certified for use on US Army Apache helicopters and Apaches, in international fleets that need an affordable upgrade to the Hydra-70 rocket. Since 2009, the Talon LGR has been launched from AH-64D and OH-58D helicopters against stationary and moving targets. Talon is currently in full-rate production as part of a $117 million contract with the UAE. **Applications:** stationary and moving targets **Guidance:** semi-active laser guidance and control **Operating platforms:** AH-64D, OH-58D **Dimensions:** 70mm

Roketsan ▸ Cirit

The Cirit 70mm Laser Guided Missile was designed to fill the gap between cheap, unguided rockets with low-precision and high-cost, guided antitank missiles. In 2013, Roketsan and Tawazun signed an agreement to jointly develop and produce the Cirit Laser Guided Missile for the UAE Armed forces, and by 2014 more than 1000 had been delivered to the armed forces of Turkey and the UAE. **Applications:** use against light armoured/unarmoured vehicles, stationary and moving vehicles and bunkers **Length:** 1.9m **Weight:** 15kg (without canister) **Diameter:** 70mm **Range:** 1,500-8,000m **Guidance:** mid-course guidance with MEMS-IMU and magnetometer, terminal guidance with semi-active laser seeker **Operating platforms:** helicopters (AH-1W, T-129, ATAK), UAV, land vehicles, light assault aircraft, naval platforms and stationary platforms **Warhead type:** multi-purpose warhead, armour piercing, personnel, incendiary

TDA Armements ▸ Aculeus LG

The Aculeus LG has been conceived as a low-collateral-effect warhead which limits damage to a 20m radius, offering sub-metric precision on static and moving targets, according to TDA. The in-flight programmable Aculeus LG includes laser coding and inflight built-in testing before rocket motor ignition. The Induction Laser Guided Rocket follows a ballistic trajectory for much of its flight until it receives a course correction order from the aircraft. In 2015, TDA announced it will manufacture, qualify and launch serial production of an initial batch of 68mm Aculeus LG rockets for the French Army's ALAT Airbus Helicopters Tiger HAD combat platforms from 2019. **Guidance:** semi-active laser STANAG 3733 - guidance algorithms: patent TDA EP 1 785 688 B1s - lock-on-after-launch capabilities. **Weight:** 8.8kg **Range:** ~1,000-5,000m **Operating platforms:** all platform types **Warhead type:** low collateral effect warhead

Rockets (unguided) ▸ Avibras Indústria Aeroespacial ▸ Skyfire

The Skyfire rocket system is the latest generation of air-to-ground 70mm rocket systems developed by Avibras. The system consists of high-energy rocket motors, different warheads and launchers with armament control systems for almost all types of fixed-wing aircraft and helicopters. The system is also capable of air-to-ground operations from towed vehicles or on mounted light vehicles. **Length:** 1.43m complete M-9 motor with HE/M1 **warhead Weight:** 11.4kg complete M-9 motor with HE/M1 warhead **Diameter:** 70mm **Max speed:** supersonic **Range:** up to 6,000m **Warhead:** AVC-70/HE; AVC-70/E (Exercise, inert); AVC-70/F (Flechette); AVC-70/TS (Practice Smoke); AVC-70 PE (Anti-runway) **Warhead weight:** 3.8kg (HE/M1) **Propulsion rocket motor:** composite propellant motor stabilised by wrap-around fins **Launcher:** 7-tube AV-LM-70/7-SF or 19-tube AV-70/19-SF **Operating platforms:** several types of helicopter

Forges de Zeebrugge ▸ 2.75in Rocket System

The 2.75in or 70mm Rocket System is an air-to-ground rocket system that is designed to provide terminal effectiveness at a low cost. The rocket system is effective against most of the battlefield targets, such as light armoured vehicle, infrastructure and light watercraft. They can also address missions such as target-marking or show of force. The rocket system meets international standards and is in service in 30 different NATO and non-NATO militaries. **Warhead:** FZ71 HEGP 4.3kg; FZ319 HEAP 4.3kg; FZ181 Flash 4.3kg; FZ120 Practice 4.3kg; FZ149 Multi-dart AMV 3.4kg; FZ122 Flechettes 5kg **Launcher:** 7 tube FZ233 (26kg); 12 tube FZ231 (31kg); 19 tube FZ225 (46kg) composite launchers **Operating platforms:** Tiger, H22M, H135M, Bö 105, Panthère, Bell 206, 406, 412, AW109, Rooivalk, others **Propulsion rocket motor:** extruded double base grain - FZ90 wrap-around fins; impulse 680daN/s FZ67/68 folding fins; impulse 515daN/s MK4/40 folding fins; impulse 512daN/s

General Dynamics Ordnance and Tactical Systems ▸ Hydra 70

General Dynamics is the system integrator of the 70mm Hydra-70 family of rockets. The rockets include unitary and cargo warheads for use against point and area targets. These warheads are capable of area suppression and defeating threats at extended ranges as well as providing battlefield obscuration, illumination and marking. The system contains three components: the MK66 MOD 4 rocket motor, one of the nine warheads and the associated point-detonating, omni-directional, remote-set fuses. Hydra-70 is launched from the existing seven and 19-tube launchers. Over four million Hydra-70 rockets have been produced since 1996. **Diameter:** 70mm **Range:** around 5km **Launcher:** M260, M261, LAU-61, DA/LAU-68 EA **Operating platforms:** AH-1, OH-58D, Bell 406CS, AH-64A/D, MD 500 series **Propulsion rocket motor:** Mk 66 wrap-around fin rocket motor with EMI protection circuits for shipboard operations, total impulse 687kg over 1.07s

TDA Armements ▸ Aculeus HE_IMP and HE-MM

TDA's Aculeus HE-IMP is an unguided, high explosive impact rocket. The Aculeus HE-MM is an HE multi-mode rocket designed for the destruction/neutralisation of elements entrenched behind an obstacle ('airburst' mode) and the destruction/neutralisation of small infrastructure or vehicles (point-detonating mode). It is possible to mix these HE systems with MD rockets. **Weight:** 7.5kg or 8.8kg **Range:** ~500m to ~5,000m

TDA Armements ▸ Aculeus MD-36 and MD-432

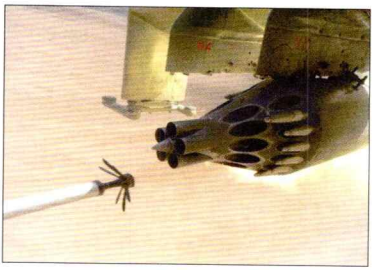
The Aculeus MD-36 unguided multi-dart rocket provides 36 darts for the neutralisation of columns of light armoured vehicles. The Aculeus MD-432 provides 432 darts to attack dispersed troop. It is possible to mix the MD-432 and MD-36 multi-dart systems with the HE-IMP and/or HE-MM. **Applications:** neutralisation of columns of light armoured vehicles **Weight:** 7.5kg or 8.8kg **Range:** ~500m to ~5,000m

TDA Armements ▸ Aculeus P and P&M

The Aculeus P (Practice) is designed to provide impact effect only (dust) and is a low-cost munition. The Aculeus P&M (Practice and Marking) provides marking of a target for a close-air support mission. It produces a smoke screen for ground force cover. Both of these TDA unguided induction rockets can be shot from any launcher of the Telson family. **Applications:** practice and target marking **Weight:** 7.5kg or 8.8kg **Range:** ~1,000m to ~5,000m

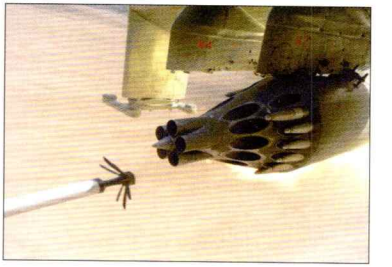
Vympel ▸ S-5

The S-5 is an unguided folding-fin aircraft rocket. The first versions were adopted by the Soviet Army in the 1950s. The S-5 is a 55mm calibre rocket fired from a 57mm calibre tube used by fighter bombers and helicopters. The rocket fins fold around the body when it is stowed in the launch tube. The flight fins provide stabilising spin to the rocket, enabling it to spin at 750rpm. The rockets have been widely used in conflicts such as Afghanistan, Georgia, Iraq, Libya and the former Yugoslavia, often launched in an improvised style as a surface-to-surface missile. **Applications:** ground attacks **Length:** 1.01m **Max speed:** supersonic **Calibre:** 57mm (body diameter 55mm) **Range:** 3km **Warhead:** 4.5kg HEAT, fragmentation, shaped charge, chaff, illumination, practice **Propulsion rocket motor:** solid rocket motor **Launcher:** 16-, 19- and 32-tube UB pods **Operating platforms:** IAR 330, Mi-8, Mi-17, Mi-24



Vympel ▸ S-8 HEAT

The S-8 HEAT is a folding-fin aircraft rocket developed by the Soviet Air Force for use by military aircraft. It is currently in service with the Russian Air Force and other export customers. It was originally developed in the 1970s and entered service in 1984. It has since been developed in a variety of subtypes with different warheads including HEAT anti-armour, HE fragmentation, smoke and incendiary. The S-8 is carried in the B series of rocket pods capable of carrying either seven or 60 rockets. **Applications:** ground attacks **Length:** 1.57m **Weight:** 11.3kg **Max speed:** supersonic **Range:** 4km **Calibre:** 80mm **Warhead:** shaped charge **Warhead weight:** 3.6kg **Launcher:** 20-tube B8V20A **Propulsion rocket motor:** solid rocket motor **Operating platforms:** Ka-27, Ka-50/52, Mi-24 family, Mi-28

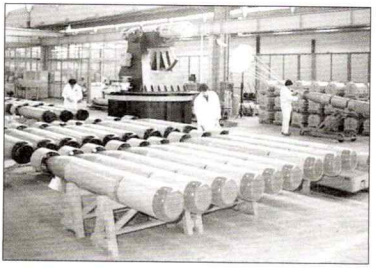


Torpedoes ▸ BAE Systems ▸ Sting Ray

Sting Ray Mod 1 is an air-launched anti-submarine warfare lightweight torpedo that can be deployed from frigates, helicopters and maritime patrol aircraft against submarine targets of all types. Utilising an acoustic homing system and navigation system the torpedo can detect, classify and attack targets autonomously. It is produced by BAE systems and is in service with the UK RN and RAF. It has also been selected by the Norwegian Armed Forces and is capable of integration into surface and air platform mission systems. In March 2017, the RN's HMS Westminster tested the Sting Ray torpedo after completing a two-year refit conducted by BAE. **Length:** 2.7m **Diameter:** 325mm **Warhead:** insensitive munition, directed energy (shaped charge), weight and configuration classified **Propulsion:** battery-operated pump-jet propulsor **Guidance:** active (FM) and passive onboard sonar **Operating platforms:** Lynx, AW159, Sea King, Merlin

Eurotorp ▸ A244/S Mod 3

The A244/S Mod 3 Lightweight Torpedo represents the latest upgrade of the A244/S family, designed to counter the threat posed by both modern conventional and nuclear submarines. The upgrade from the A244/S includes a new and more powerful propulsion battery with an increased number of cells and an electrolyte circulation system that has provided a 50% increase in the endurance of the weapon. The introduction of an electronic controller has enabled variable speed propulsion with further advantages for endurance and probability. Over 1000 units have been produced for 15 navies. **Length:** 2.7m **Diameter:** 32.4cm **Max speed:** speed variable between 28 and 36kt **Warhead:** blast charge **Operating platforms:** AS-61, AB 212ASW, Lynx, Cougar, Panther, S-70B **Engagement distance:** >8,000m **Propulsion:** electrically driven propeller **Guidance:** active, passive and mixed-mode sonar incorporating adaptive search patterns **Depth:** 10-600m



Eurotorp ▸ MU-90/Impact

The MU90is a NATO-interoperable, multirole, fire-and-forget LWT designed to counter nuclear or conventional submarines. This includes those that are acoustically coated, capable of deep-diving, fast-evasion and deploy anti-torpedo effectors. The torpedo is capable of operating in shallow waters of the littoral and was developed to respond to the ASW operational needs of current warfare. Over 1000 rounds have been produced and it is in service with a number of NATO Navies including Australia, Denmark, France, Germany, Italy and Poland. **Length:** 2.96m **Weight:** 295kg approx **Diameter:** 32.4cm **Max speed:** 29-50kt+ **Warhead:** shaped charge **Depth:** 3-1,000m+ **Operating platforms:** Lynx, Super Lynx, NH90, AW101, SeaSprite, Mi-14 **Engagement distance:** 15,000m+ **Propulsion:** electrically driven propulsor using seawater-activated battery **Guidance:** multiple transducer, multiple frequencies, active/passive sonar

Raytheon ▸ Mk 50 Lightweight Torpedo

The MK 50 torpedo was utilised by USN surface ships and aircraft and developed by Raytheon to replace the MK 46 torpedo. It was first authorised for fleet use in October 1992. The MK 50 was designed to counter the fast, deep-diving, double-hulled nuclear submarine threat. Relative to the MK 46, the MK 50 has increased range, improved counter-countermeasure logic, greater lethality, speed, depth and endurance. Significant technical improvements were also made, including a Stored Chemical Propulsion System and improved weapon tactics and signal processing software. A software upgrade programme for the MK 50 was conducted in the mid-1990s to enhance the MK 50's shallow water performance. **Length:** 2.9m **Weight:** 363kg **Diameter:** 32.4cm **Max speed:** >40kt **Warhead:** shaped charge **Operating platforms:** SH-60 family **Propulsion:** closed-cycle steam turbine, stored chemical energy source **Guidance:** active/passive sonar **Depth:** >600m

Raytheon ▸ MK 54 Lightweight Torpedo

The MK 54 lightweight torpedo is designed to deliver a devastating blow to submarine threats in both deep and shallow water and in various acoustic environments. The MK 54 can be deployed from a surface ship, helicopter or fixed-wing aircraft to track, classify and attack underwater targets. It uses processing algorithms to analyse the information, edit out false targets or countermeasures and then pursue identified threats. The MK 54 is the next-generation of the MK 46 torpedo and enables navies to convert existing MK 46 systems into MK 54 torpedoes using the low-cost MK 54 upgrade kit. The system utilises the MK 46 warhead and propulsion subsystems and technologies from the MK 50 ALWT and submarine-launched MK 48 ADCAP and is in use with the USN. The system, which has been in production since 2003, has been exported to Australia, India and Turkey. **Length:** 2.6m **Weight:** 231kg **Diameter:** 32cm

Raytheon UK ▸ Mk 46 Mod 5A (SW)

The Mk 46 Mod 5A (SW) is the latest model of the Mk 46 family, used by 25 countries, in service with the USN and offered for export. The USN introduced the MK 46 Mod 5A (SW) Service Life Extension Program torpedo in 1996. It has improved counter-countermeasure performance and target acquisition, and provides a bottom-avoidance preset alongside improved maintainability and reliability, states the company. **Length:** 2.6m **Weight:** 231kg **Diameter:** 32cm **Max speed:** slow for stealthy search, fast for attacking high-speed submarines **Warhead:** shaped charge **Propulsion:** liquid monopropellant Otto motor **Guidance:** active/passive sonar, digital autopilot with pre-programmed search, re-attack patterns **Operating platforms:** Sea King, Seahawk, Bell 212, Seasprite/Super Seasprite, Lynx, Panther

Saab ▸ Torpedo 45

The Torpedo 45 is an ASW lightweight torpedo that can be used against shallow-water targets and surface vessels. It is controlled using wire guidance and has a hydro-acoustic homing system. The system can be launched from submarines, surface vessels and helicopters, and can be wire-guided from a flying or hovering helicopter. Its warhead has a main charge that is capable of use against conventional submarines and causing damage to light surface vessels. The Torpedo 45 is operational with the Swedish Navy. **Applications:** ASW and surface targets **Length:** 2.85m **Weight:** 320kg including battery and communication wire **Diameter:** 400mm **Propulsion:** electric DC motor with gearbox **Operating platforms:** various helicopters

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EQUIPMENT

PROTECTION SYSTEMS

The following helicopter-mounted protection systems are featured in this section:

- Armour
- Chaff, flare and decoy systems
- Integrated self-protection systems
- IR jammers
- Laser warning receivers
- Missile launch detectors and approach warners
- RF jammers
- Radar warning receivers

The systems are listed alphabetically by manufacturer.

The data in these entries has been supplied by the manufacturers. Further information can be obtained by contacting companies directly.

If your company produces a protection system for helicopter use which you believe should be listed in this section, please contact Karima Thibou at karima.t@shephardmedia.com to ensure it appears in the Shephard Plus online database (shephardplus.com) and is included in the next print edition.

ABOVE: A Lynx helicopter from HMS *Manchester* deploys its counter heat-seeking missile flares during an exercise at sea. (Photo: UK MoD)

ARMOUR

3M TECHNICAL CERAMICS

Ballistic Aircraft Armour

3M's ballistic protection ceramic armour is designed to be lightweight and flexible. Hot-pressed lightweight boron carbide is used for the ballistic protection of helicopter seats. Since the 1960s 3M has supplied boron carbide tiles for helicopter seats. Since 2012 the company's portfolio has expanded to include complex panels in boron carbide. 3M also supplies silicon carbide for use in helicopters, in particular for complex geometries or lower ballistic protection levels. Applications: ballistic protection of helicopter seats Operating platforms: aircraft

ARMORWORKS

Helicopter Armour

ArmorWorks supplies traditional steel and lightweight composite armour kits for helicopters. Its products include seat, cockpit and full cabin armour. Its floor panels can be installed and removed by front-line personnel. Ballistic protection levels can be changed to meet different threat levels. The company has supplied kits for US Army AH-64 Apache, CH-47 Chinook, OH-58D Kiowa helicopters, USN and USCG H-60s and USMC CH-46Es. The ceramic composite armour kit for the AH-64 has been installed on the US Army AH-64s since 2007 and saves more than 136kg when compared with the conventional steel armour previously used. According to ArmorWorks, the new lightweight armour also provides better ballistic protection. Applications: ballistic protection armour kit Operating platforms: US Army AH-64 Apache, CH-47 Chinook, OH-58D Kiowa helicopters, USN and USCG H-60s and USMC CH-46Es Material: Ceramic composite armour Protection levels: variable depending on threat level of operation

ARMOR OF AMERICA

Helicopter Armour

Armor of America (AoA) produces custom armour kits for any rotary wing aircraft. AoA helicopter armour protects areas such as the cockpit floor and doors, cabin floor and walls, chin bubble, crew seats, gunner stations and transmission walls. AoA has been producing armour for over 35 years and has provided armour products for over 300 helicopters, including platforms by Airbus Helicopters (AS330, AS332, AS350, AS355, AS365 Bö 105, BK 117, H120, H135M, H155, H225M, HH-65), Bell (Bell 205, 206, 212, 407, 412, 427, UH-1H, Huey II), Boeing (CH-46, CH-47), Leonardo (AW109, AW139), MD Helicopters (MD 500, MD 530, MD 600, MD 900), Russian Helicopters (Mi-8/-17) and Sikorsky (CH-53, SH-3/S-61, H-60). AoA's service is a turn-key solution that offers services such as visits to the customer's location, measurement of the aircraft, identification and discussion of specific requirements, production of certified drawing package, the manufacture, delivery and installation of the kit and training in how to maintain, install and remove the armour. Applications: ballistic protection Operating platforms: wide range of helicopter models

ASU BALTIJA

Armour set for Mi-17

ASU Baltija designed a protection kit for three MI-17s for the Rwandan MoD. The armour weighs 200kg and can be fitted on any Mi-8/17 family aircraft. The armour is designed to protect the engine, hydraulic unit, generator and main gearbox. The ballistic protection panels are made of lightweight ceramics SIC/aramid and Dyneema polyethylene fibre. Four ceramic composite panels provide side protection of the helicopter crew and are placed on special mounts outside the cockpit, fixed by screwed fixers. Two composite plates are also fixed on both sliding pilot windows from the inside. Twelve Dyneema and two Armox steel panels are installed on the cockpit floor and bulletproof glass is installed on a special frame inside the cockpit between the front windows and instrumental panels, providing pilots with good protection and visibility. Finally, two armoured steel plates provide protection beneath the control pedals. The armour kits are designed to meet NIJ Level III, providing defence against rounds from weapons such as the 5.56mm M16 and the 7.62mm AK-47. Applications: aircraft body armour Protection levels: NIJ III Material: SIC/aramid and Dyneema polyethylene fibre Operating platforms: Mi-8/-17

CERADYNE

3M Aircraft Armor Systems

Ceradyne developed the Defender armour systems that included ceramic armour seats, components and panel systems for military helicopters. The company supplied components, ceramic tile kits or integrated seating for existing and development helicopters. Ceradyne is now a wholly owned subsidiary of 3M, which markets its helicopter armouring products as 3M Aircraft Armor Systems. According to 3M, modular components allow for simple, customisable integration while ceramic strike-faces are designed and tested to shatter armour-piercing bullets on impact – from 5.56 to 12.7mm – while composite backing absorbs residual energy. Seating and wing panels are typically constructed from moulded aramid composite shells and finished with a durable nylon fabric to help increase protection from armour-piercing ballistics between 7.62 and 12.7mm. Applications: ceramic armour seats, components and panel systems Protection levels: 7.62 and 12.7mm armour-piercing rounds Material: ceramics, nylon fabric Operating platforms: AH-64 Apache, Gazelle, H225M, AH-1 series, H-60 series, CH-47 Chinook

IAI GOLAN INDUSTRIES

IAI Crashworthy Seats

IAI Golan provides military helicopters with ballistic armour pilot seats, operator seats and helicopter/tiltrotor troop seats. The seats are fully adjustable with longitudinal, vertical, swivel and recline adjustments provided. The armour is tested to MIL-STD-810 environmental requirements and is designed to be easily reconfigured in the field from armoured to non-armoured configuration. The troop seats feature a foldable seat pan and backrest, they also enable backpack wearing and are floor-mounted, side-facing. These seats have been chosen by the USN for the V-22 tiltrotor aircraft. Applications: seat armour for helicopter

pilot and crew Certifications: MIL-STD-810 Operating platforms: V-22 tiltrotor aircraft

ISBI ARMORING

Helicopter Ceramic Armour

ISBI Armoring provides ballistic protection kits for both civil and military helicopters. The armour is constructed from silicone carbine tiles, which are laminated with rubberised Twaro. The use of silicon carbine tiles provides a weight saving of 20% when compared with alumina tile armour, according to the company. The weight to provide protection from 7.62mm is 40kg/sqm. ISBI produces the armour for cabin floors and on request for lighter aircraft such as the Bell 206. The company also provides armour for the Black Hawk, which is generally installed to protect the passenger area. ISBI has armoured over 20 helicopters for both civil and military customers in France, Russia and the US. Applications: Aircraft body armour Protection levels: Protection against 7.62mm Material: silicone carbine tiles with rubberised Twaro Operating platforms: Bell 206 and Black Hawk UH-60

NORINCO

Aircraft Armor

Norinco Shanghai has developed bullet-proof and anti-explosive technologies to armour aircraft by using a variety of armoured panels, lightweight composite materials and bullet-proof structures. Norinco is able to upgrade various helicopters, transport aircraft and fighter jets.

PERMALI GLOUCESTER

Lightweight Armour Systems

Permali uses advanced composite and ceramic materials to provide lightweight ballistic protection for helicopters. The materials used by Permali include UHMWPE, aramids and ceramics. They provide protection levels ranging from small arms to heavy machine gun fire. Armour panel constructions meet the requirements of FAR/CS25 and FAR/CS29. The company has developed an armour upgrade for the CH-47 Chinook that provides protection to both the cockpit and cabin areas. It is a modular system, allowing for installations according to mission requirements. This equipment is in active service with the UK RAF and the Royal Netherlands Air Force. Operating platforms: CH-47 Material: UHMWPE, aramids and ceramics Protection levels: small arms to heavy machine gun fire Certifications: FAR/CS25 and FAR/CS29

PLASAN SASA

Lightweight Armor Airborne Solutions

Plasan's integrated solutions include modular, portable or fixed add-on-armour kits. The company's installation kits can be used on multiple models of the same aircraft and it offers shipping to remote locations, as well as rapid, on-site, mid-mission installation and on-the-fly repair. Plasan develops and fields lightweight armour 'Cockpit Protection' products for aircraft operating forward, which are designed to provide a high level of protection for flight crews and passengers. The lightweight armour is designed to provide high protection levels with minimal added weight. The solutions use materials that ensure specified threat levels are met. Products include transferable armour kits that can be moved from one like aircraft to another. Applications: Cockpit protection, helicopter armour Operating platforms: fixed- or rotary-wing aircraft

PROTECH ARMOR SYSTEMS

Protech Helicopter Armour

Protech aircraft armour kits are designed and manufactured by Protech for a range of applications. Add-on armour kits can be customised to meet mission, weight and performance objectives for all types of ball and armour-piercing threats. According to Protech, the lightweight composite design reduces the weight of the armour system while offering multi-hit ballistic performance. Protech's aircraft armour reaches the FAA requirements for fortified cockpit doors. The ballistic panels can be installed and in most cases removed by front-line personnel with no special tooling. Armour systems can also be transferred from one aircraft to another. Replacement panels are available, which eliminates the need to replace the full kit. Features of the FAA-certified aircraft armour kit include non-reflective polyurethane protective coatings for slip-resistance, vertical burn resistance and resistance to (and protection from) a variety of environmental and chemical conditions. Applications: helicopter armour Protection levels: all types of ball and armour-piercing threats Certifications: FAA approved Operating platforms: Rotary-wing aircraft

TENCATE ADVANCED ARMOR

Aircraft Armour

TenCate Advanced Armour designs 'built-to-print' and 'built-to-spec' ballistic protection panels, which can be quickly installed or de-installed. The ballistic protection is achieved through the use of lightweight materials such as TenCate Liba CX or TenCate Ceratego CX. TenCate Liba is a material made with pellets of silicone carbide or boron carbide. TenCate also provides whole-life support for ballistic protection products. Transparent armour is produced to protect the cockpit crew while enabling continued visibility. Pilot seat protection solutions can be integrated into various aircraft designs without impairing the operability of the equipment, protecting the pilot crew against penetrating projectiles and against trauma sustained from turbulence and other environmental threats. TenCate's modular floors are installed with the use of QR-skewers and can be designed in collaboration with the original equipment manufacturer or be integrated into existing designs as a retro-fit application. Side doors and ramps can be integrated into the overall design of the flooring system to provide additional protection. Exterior aircraft protection solutions can be designed with radar-transparent armour which are created with system performance and centre of gravity in mind. 3D composite armour solutions can also be provided for the protection of engines and exhaust systems. These solutions are designed for extreme temperature performance. The ballistic protection is designed and produced in a dedicated aerospace EN91000-certified and NATO security-cleared production site. TenCate has supplied kits for the AW101 from its facility in Vissenbjerg, Denmark. Operating platforms: AW101 Certifications: NATO STANAG 4569 Material: TenCate Liba CX or TenCate Ceratego CX

CHAFF, FLARE AND DECOY SYSTEMS

ALLOY SURFACES

IRCM Flares

Alloy Surfaces' family of visually covert Special Material Decoy IRCM are designed to protect rotary-wing aircraft, fighters and transports from MANPADS and IR-guided AAMs in both reactive and pre-emptive dispensing scenarios. The M211 was developed under the US Army Advanced IRCM Munitions programme for helicopter protection for use in ALE-40/-45/-47, M130 and any CMDS capable of employment of countermeasures. The MJU-50/B and MJU-51A/B were developed under the joint USAF/USN Advanced Strategic and Tactical IR Expendables programme; the MJU-64/B and MJU-66/B were developed by the USN and are compatible with ALE-40/-45/-47, M130 and any CMDS capable of employing these form factors. User platforms: The MJU-49/B is suitable for all aircraft fitted with ALE-39 or capable of expending 5.8in, 36mm round decoys. MJU-52/B BOL IR and Hot BOL IR L5A2 decoys are designed for employment with the Saab BOL dispenser Dimensions: M211: 24x24x203mm, MJU-50/B: 24x24x203mm and MJU-51A/B: 50x24x203mm

ARNOLD DEFENSE

SUU-25 F/A Flare Dispenser

The SUU-25 F/A flare dispenser is for use aboard high-performance aircraft to deploy LUU-1 or LUU-2 illumination rounds. The dispenser can carry eight rounds in four tubes, and uses two five-pin firing connectors through a stepping switch. A small explosive charge is used to eject the parachuted illumination round aft, behind the aircraft. Pod width: 35.4cm (Dia) Empty pod weight: 117.9kg Pod length: 241cm

ASELSAN

CMDS

The Helicopter Counter Measures Dispensing System (CMDS) is designed to dispense chaff/flare decoys to protect rotorcraft against RF/IR-guided missiles. It comprises five LRUs: system control unit, dispense control unit, dispenser base, magazine and safety switch. The CMDS dispenses 25x25mm IR or RF decoys. The system is also able to dispense each half of RR-180-type dual-chaff decoys independently, increasing the total number of RF decoys by a factor of two. Each magazine can be loaded with mixed types of decoys. The onboard MDF contains up to 2,400 individual dispensing programs. The dispense programs can be initiated manually, semi-automatically or automatically, with two payloads dispensed simultaneously if required. In semi-automatic (dispensing with pilot consent) and automatic (dispensing initiated by system) modes, the system receives warnings from external missile warning systems, RWRs or laser warning receivers. Applications: protect helicopters against RF/IR-guided missiles Capacity: up to four magazines can be connected to a DCU, with each magazine containing 30 decoys Decoy length: 25mm Decoy width: 25mm

The ALE-47 Airborne Countermeasure Dispenser System is in operation with the US military, automatically launching RF and IR countermeasures to defeat incoming missiles. (Photo: BAE Systems)

SPREAD

Self Protection Expendables Airborne Dispenser (SPREAD) is a CMDS designed to increase the survivability and mission effectiveness of airborne platforms against RF and IR threats. SPREAD is capable of operating with any RWR/MWS/LWR via MIL-STD-1553B data bus and discrete interfaces. It also has glass cockpit and NVG-compatible versions and is capable of dispensing 25x25mm chaff, 25x25mm dual chaff, 25x25mm flare, Multi-Blu-3 and other chaff/flare cartridges with similar dispensing characteristics. The system consists of five LRUs: system control unit, dispense control unit, dispenser base, magazine and safety switch. The system was developed under SSM contract. It has been operational since 2006. Operating platforms: AH-1P, AH-1W, Mi-17, AB205, AS532, S-70A and T129

BAE SYSTEMS

AN/ALE-47(V) Countermeasure Dispenser System

Operated by the US military, ALE-47 is claimed to be the most widely used CMDS in the world. Manufactured in Florida, this system is readily available with a much shorter lead time than other similar systems, according to the company. It has been interfaced with numerous companion sensor systems and has been fielded by over 25 countries on over 30 platforms. It is interchangeable with obsolete ALE-40, ALE-39 and M-130 systems. When the aircraft's sensors detect a threat, the CMDS automatically launches RF and IR countermeasures at the optimum time to defeat incoming missiles. The ALE is compatible with a wide variety of countermeasures such as different types of flares and chaff. It is also designed to work with future countermeasures. The AN/ALE-47 is manufactured by both Extant Aerospace and BAE Systems. Launch envelope: Each dispenser can hold five different types of countermeasures for a total of 30. The whole system can accommodate up to 32 dispensers on fixed-wing aircraft and 16 on rotary-wing aircraft.

Chaff and Flare Cartridges

The family of chaff and IR expendables includes M206 207x25x25mm (0.04kg) IR decoy flare; MJU-x 264x74mm (0.4kg) IR decoy flare; RR-129/AL 147x36mm (0.23kg) chaff cartridge; RR-136/AL 196x40mm (0.09kg) chaff cartridge;

RR-170/AL 207x25x25mm (0.03kg) chaff cartridge; RR-171/AL 31m long (19kg) chaff roll; and RR-179/AL 19kg chaff roving bundle matching any frequency in A-L bands. User platforms: Mirage family, F-16, F/A-18, C-160, C-130

M130 General Purpose Dispenser

The M130 General Purpose Dispenser System provides survival countermeasures against radar-guided weapon systems and IR-seeking missile threats. It is able to disperse 30 decoy flares or chaff cartridges manually or automatically, cued by the AN/ALQ-156(V) missile detector. The M-130 General Purpose Dispenser is electrically powered and constructed of modules to facilitate quick replacement. The M-130 Dispenser consists of a dispenser assembly, payload module assembly, electronics module and control panel. The system is designed to dispense M206 flare decoys from helicopters and fixed-wing aircraft, including the CH-47D, EH-60A, MH-47E, OV-1D, RV-1D and RC-12. The capability to dispense both flare and chaff decoys can be achieved by adding a second dispenser assembly and payload module assembly to the aircraft. When dispensing flare decoys, the M-130 and AN/ALQ-156 combination provides for the reduction or elimination of the enemy's ability to hit and destroy the aircraft by the use of IR homing missiles. Weight: 0.15kg (chaff), 0.20kg (flare) 0.06kg (impulse) Decoy length: 20.52cm Decoy width: 2.51

BAE SYSTEMS ROKAR

ACDS

The Advanced Countermeasures Dispensing System (ACDS) is a combat-proven computer-controlled airborne system, possessing capabilities for chaff, flare and decoy dispensing. Functioning as a standalone unit or integrated with an EW suite, ACDS includes a range of smart dispensers. The NVG-compatible mini-control and display unit provides display of the threat direction detected by EW sensors and generates an audio warning. The system interfaces with EW warning systems, aircraft avionics and smart dispensers of any type.

ADDS

The Advanced Digital Dispensing System (ADDS) is a computer-controlled, threat-adaptive CMDS for use on fast jets, helicopters, transport and maritime patrol aircraft. Via its cockpit control and display unit, ADDS can dispense chaff, flare, RF and future types of expendable payloads. ADDS operates in automatic, semi-automatic or manual modes. It can fire dual-chaff cartridges that double the number of onboard stores per mission. In addition, ADDS can dispense multiple payloads simultaneously to provide a multispectral response or a stronger decoy signal when needed.

BHARAT DYNAMICS

CMDS

The Bharat Dynamics Counter Measures Dispensing System (CMDS) is an airborne defensive system providing self-protection to aircraft by passive ECM against radar-guided and IR seeking AAMs and SAMs. Protection for the aircraft is achieved by misguiding the missiles by dispensing chaff and/or flare payloads. User platforms: Jaguar, LCA, MIG-29, Mig-35, Mirage, Su-30 jets; ALH, LCH helicopters; AEW&C FRA and S&TT (Embraer) aircraft

CEIEC – CHINA NATIONAL ELECTRONICS IMPORT & EXPORT

GT-1

The GT-1 is a CMDS capable of ejecting chaff (up to 68 cartridges) that covers 2-18GHz and flares (up to 32 cartridges) covering 1.5-5µ IR waveband. Capacity: chaff (up to 68 cartridges), flares (up to 32 cartridges)

CHEMRING COUNTERMEASURES

Alloy Surfaces and Kilgore IRCM flares

Chemring Countermeasures develops and manufactures the Alloy Surfaces and Kilgore range of airborne IR flares that are compatible with most available dispensers on a variety of platforms. Tahey form a family of visually covert, special material decoy IRCM designed to protect fighter, transport and helicopter aircraft from MANPADS and air-to-air IR-guided missiles in both reactive and pre-emptive dispensing scenarios. The MJU-50/B and MJU-51/B were developed under USAF ASTE programme; the MJU-64 was developed by the USN, and is compatible with ALE-40, -45, -47, M130 and any CMDS capable of employing these form factors. The M-211 (1x1x8in) was developed under US Army AIRCMM programme for helicopter protection and use in ALE-40, -45, -47, M130 and any CMDS capable of employment of 1x1x8in countermeasures. MJU-49 can be used for all aircraft fitted with ALE-39 or capable of expending 36mm round decoys. MJU-52/BOL IR decoys are for employment with the Saab BOL dispenser. The flares include standard MTV, spectral, aerodynamic and thrusted characteristics in a variety of form factors. Standard flare products manufactured include but are not limited to the KC-002 IR decoy flare, KC-005, KC-006, M206, MJU-7A/B, MJU-53/B in rectangular format; the KC-001, KC-004, KC-32 and KC-38 in round format; and the MJU-10/B, MJU-32A/B, MJU-38A/B, ALA-17/C, M212, MJU-39/B, MJU-40/B, and KC-039. Applications: IR decoy flares Operating platforms: Variety of high-performance aircraft

Chaff and Flare Expendables

Standard and customer-specific IR and RF countermeasures, including aerodynamic, thrusted and spectral flares in a variety of formats to counter missile threats. Compatible with most dispenser formats. Proprietary Modular Expendable Block is based on the need to increase the number of chaff salvos. Suits a range of digital dispensers. User platforms: AN/ALE-39, -40, -45, -47 and M130, Terma, BDL, MBDA, Rokar, MES ECDS, Thales, Saab and Russian dispensers

DTS

DM/A-202

The DM/A-202 is a chaff and flare dispenser designed for combat aircraft and helicopters. It consists of a control and display unit and four launching units (expandable to eight). The CDU shows cartridges remaining and includes a dispensing mode selector. Each launch unit includes firing circuits and a removable magazine, and may be installed internally or externally onto the aircraft's rear fuselage or the sides of the ventral and wing pylons. Internal and semi-recessed installation is also possible. Applications: RF/IR; passive Capacity: normal payload is 108 chaff or 54 flare cartridges

GLOBAL INDUSTRIAL & DEFENCE SOLUTIONS (GIDS)

Mohafiz

Mohafiz is an IR and electromagnetic (RF) countermeasure system for airborne objects protecting against radar guided missile and IR missiles. It is integrated with radar warning receiver and missile approach warning system. Ejection velocity: 0.5A pulse for 50ms Burn time burn duration: >4s

IMI SYSTEMS

FG-3/-6/-9 IR Flares

The FG-3/-6/-9 IR Flares are fully compatible in form, fit and function with M206 and MJU-7B flares respectively, and all use magnesium/PTFE cartridge pellets. The decoy flares can be ejected from modern fighters, such as the F-16, F-15 and F-4, as well as from transport aircraft such as the C-130 Hercules. The flares are dispensed from AN/ALE-40/47, ADDS, SAMP 60/120/240, with the FG-3 also being deployed with the M130 (see separate entries). Dimensions: FG-3: 25x25x205mm, FG-6: 25x51x205mm, FG-9: 64x51x205mm

Multi-Blu Cartridge

The Rocket Systems division of IMI has developed a decoy flare system, Multi Blu, which increases the protective output afforded by other decoys within the same environment. By splitting standard flares such as the F-3 (M-206 EQ) pellet into three parts with built-in ejection delays, each Multi Blu flare can provide up to three times the protection of a standard flare, according to the company. It is used in conjunction with the SAMP 60/120/240 dispenser. Weight: 230g Decoy length: 203mm Decoy width: 25mm

SAMP 60/120/240A-series chaff and flare dispensers

The SAMP family of standalone dispensers can be integrated into a complete self-protection EW suite. SAMP 60A consists of a control and operating panel and two 30-round chaff/flare magazines, while SAMP 120A/240A holds four to eight magazines, each with 30-round chaff/flare. The system allows selection of manual, semi-automatic and automatic operating modes, trigger modes and continuously displays inventory. It has three BIT levels and is NVG-compatible. The system holds up to 16 dispense, escape or jettison programmes and supports operation of two programmes in parallel. The SAMP system is used in conjunction with IMI's Multi Blu helicopter protection system. Capacity: SAMP 60A – two 30-round chaff/flare magazines; SAMP 120A/240A – holds up to eight magazines, each with 30-round chaff/flare

LACROIX

Fighter Countermeasures

Lacroix makes a range of chaff IR and EO decoy cartridges dedicated to the protection of all airborne platforms. Decoy cartridges are compatible with any type of dispensers, whose signatures are optimised for the type of platform to be protected. Verdite (IR) and Junon (chaff) are three-shot cartridges that Lacroix produces: dual-band IR flares to defeat advanced threats and a wide RF bandwidth chaff cartridge optimised to protect helicopters. Verdite and Junon are integrated onto Mucalir ammunition for the Saphir dispenser, Helir ammunition for Elips dispenser (see separate entries), M119 magazine and any other type of existing dispenser. Calibre: 40mm, 50mm, 55mm, 60mm Decoy width: 19mm (Dia) cartridges

LEONARDO AIRBORNE & SPACE SYSTEMS

AGP

The Aircraft Gateway Processor (AGP) is an aircraft survivability equipment (ASE) controller, contained within a single flight-qualified LRU. The AGP provides the ability to integrate federated ASE sensors and countermeasures at initial aircraft configuration or post-installation upgrade. This provides a combined threat picture and prioritised tactical response per the user-programmed pre-flight message. The AGP is installed by Boeing as aircraft 'A'-Kit on all new and remanufactured AH-64D/E Apache Longbow helicopters. Length: 18cm Width: 13cm Height: 19cm Weight: 3.45kg Operating platforms: AH-64D Block II and III; UK MoD front-line combat helicopters

MBDA

ELIPS-NG

A chaff and flare dispenser system in service on many types of helicopters (Cougar, Caracal, Panther, Sokol). It can operate up to 12 cartridge dispenser modules with magazines housing several types of decoy ammunition. The management and distribution unit provides the management of ELIPS-NG and the interface with the aircraft and warning detectors of the EW system when available. It stores the mission parameters and elaborates the ejection programs. It also provides automatic identification of the type of ammunition loaded. The cockpit control unit includes the controls and displays of the system. A rotary switch selects between automatic, semi-automatic and manual ejection modes. A selector allows ejection on either left, right or both sides. ELIPS-NG comes with a mission planning system to generate the library parameters and upload it into the ELIPS-NG before mission. It can take the form of an autonomous station or software to be embedded in an EW system mission planning system. Launch envelope: cartridge dispenser modules, management and distribution unit, cockpit control unit, magazines, ammunition

SAPHIR-M/ELIPS-NH

Saphir-M is a chaff and flare dispensing system for the Tiger and NH90 – and offered for other helicopters – derived from the Saphir system. It offers a high decoy capacity and is interoperable with a variety of decoy standards. Fully programmable and optimised for helicopter use, it can be used as a standalone installation or integrated into a DAS. The cartridge dispenser modules (CDMs) house the ammunition magazines and perform loading, identification, management of firing impulses and interface with the sequencing supply and safety unit (SSU) and magazines. The system can operate up to ten CDMs. The SSU manages the chaff and flare dispenser and interfaces with a helicopter and its warning sensors. It stores the mission parameters and the chaff/flare injection sequences, using software optimised for helicopter use. The cockpit control unit features a rotary switch that enables the pilot to select

between automatic, semi-automatic and manual chaff/flare firing, on either or both sides of the aircraft. An emergency survival input activates a specific program regardless of the actual program selected. The magazines can carry any mix of chaff/flares, reading the loaded combination from coded plugs. It can identify and use different types of decoys such as NATO 25x25x203mm, 51x25x25mm (32 per magazine). Saphir-M comes with a mission preparation software tool for the programming and uploading of ejection programme libraries prior to the mission. The ELIPS-NH is progressively replacing form, fit and function SAPHIR-M on the NH90 in the form of a mid-life update. The SAPHIR-M and ELIPS-NH are equipped with with a mission planning system to generate the library parameters and upload it into the ELIPS (decoy dispenser) before mission. The system can take the form of an autonomic or semi-automatic mode, in conjunction with Indra Sistemas ALR-400 and EADS MILDS AN-AAR 60 missile detectors. Alternatively, software can also be embedded in an EW system mission planning system. The system is fully programmable and has a high decoy capacity. On 14 June 2010, MBDA received a contract notification for the supply of SAPHIR M decoy systems to provide self-defence on the 24 Tiger HAD attack helicopters ordered by Spain from Airbus in December 2005. Operating platforms: NH90, Tiger

RHEINMETALL WAFFE MUNITION

Birdie Flares

Spectrally balanced IR decoy flares designed to protect helicopters, fixed-wing transports and fast jets through replication of the aircraft signature in MWIR. These decoy flares have a fast rise time and high radiant intensity, and are effective against modern IR homing missiles with two-colour filtering, it is claimed. Offered in two variants, the 118 Birdie and the 218 Birdie. Ejection velocity: >25m/s

Chaff and Flare Systems

Rheinametall's spectrally balanced decoys, array flares and spot flares offer protection for carrier aircraft, helicopters and jets against IR-guided missiles. It has an aircraft-like signature with fast rise-time combined with high radiant intensity, allowing protection against modern SAMs/AAMs with IR seeker heads, including those with two-colour ratio discrimination. The efficiency is seeker-tested. Examples include the DM69 A2 array flare, a 51x25x203mm flare fitting AN/ALE-40/47 dispensers.

Cirrus 118

Cirrus 118 is a development of the DM69 A2 array flare, offering improved effectiveness, says the company. It is designed to offer an aircraft-like IR signature with fast rise-time and high radiant intensity in the SW, MW and LW IR bands. It is described as effective against missiles with two-colour discrimination, and provides a large masking IR cloud effective against missiles with a small seeker FOV. The decoy cloud also blocks UV radiation. With a larger performance envelope than the DM69 A2, it is designed for low- and slow-flying aircraft, such as helicopters and tactical transports.

SAAB

BOP-L

The BOP-L family is a range of lightweight countermeasure dispensers that offer high system integration and levels of protection for helicopters and transport aircraft. The BOP-L dispensers have a flexible configuration and can be installed on new platforms or be retrofitted. The dispensers are controlled via a fully integrated chaff and flare dispenser controller prime circuit board that resides in an EW controller (EWC) which allows for automatic dispensing under the control of the EWC upon threat identification. Semi-automatic and manual firing, standby or back-up modes are also available and can be selected via the control panel. Key features of BOP-L include flight-line programmable dispensing sequences, quick reloading of dispensers by a unique built-in locking mechanism, payload misfire detection and compensation, payload and magazine identification and easy installation and removal. Launch envelope: flight-line programmable dispensing sequences, quick reloading of dispensers by unique built-

The Saphir-M is a decoy dispenser delivering countermeasures against radar and missile threats by optimised ejection of chaff and/or flares. (Photo: MBDA)

in locking mechanism, programmable back-up mode in the event of system degradation

THALES

Vicon 78

The Vicon 78 family of lightweight chaff/flare dispensing systems has manual, semi- and fully automatic threat-adaptive dispensing capability. Vicon 78 is able to interface with a range of RWR, MWS and DAS controllers. It can control up to 24 dispensers, which can be installed internally, semi-recessed, externally faired or in pods. The Dispenser module takes interchangeable chaff and flare magazines containing up to 64 payloads, or modular expendable blocks. Length: 24cm (dispenser control unit); 24cm (dispenser) Width: 15cm (dispenser control unit; 21cm (dispenser) Height: 7cm (dispenser control unit); 17cm (dispenser) Weight: 2.25kg (dispenser control unit); dispenser 11kg with flares, 10kg with chaff Capacity: dispenser module can hold interchangeable chaff and flare magazines containing up to 64 payloads, or modular expendable blocks

Vicon XF

The Vicon XF CMDS is the latest generation of Vicon-series self-protection equipment. It dispenses expendable chaff and flare payloads in programmed sequences in order to disrupt hostile IR seekers or radar tracking systems. The system will provide the capability to support future smart payloads that will further enhance survivability as well as providing logistics benefits, it is claimed. Length: 27cm (casing); 24cm (dispenser control unit) Width: 26cm (casing); 15cm (dispenser control unit) Height: 12cm (casing); 8cm (dispenser control unit) Power: 28V DC Weight: 3kg (casing); 2.2kg (dispenser control unit)

Vicon XF CMDS

Family of lightweight chaff/flare dispensing systems configured for helicopters, fast jets, large aircraft and UAVs. It has a manual, semi-automatic and fully automatic threat adaptive dispensing capability. Building on the Vicon 78 Series 455, Thales developed the Vicon XF, the latest version of the series incorporating a number of features. Vicon XF is able to interface with a range of RWRs, MWS and DAS controllers. The system has the capability to control up to 24 countermeasures dispensers, which can be installed internally, semi-recessed, externally faired or on podded mountings. A dispenser module is able to accept interchangeable chaff and flare magazines containing up to 64 payloads, or modular expendable blocks.

INTEGRATED SELF-PROTECTION SYSTEMS

ASELSAN

HEWS

Aselsan's Helicopter EW System (HEWS) is an integrated SPS, developed for fixed- and rotary- wing aircraft. Integrated via a suite CPU, HEWS provides radar, missile and laser warning, RF jamming, chaff/flare dispensing and broad situational awareness capabilities. HEWS is also integrated with the IRCM system to provide the operational status of IRCM to the pilot. HEWS receives all information from its subsystems, makes threat assessments (detection, classification and identification) and after the execution of data fusion processing, makes decisions regarding the application of the most appropriate countermeasures technique, including combined RF jamming and passive decoys, to defeat the identified radar and/or missile threat. Its design provides indicative audio warnings and alerts, in-flight event recording, PDW recording, blanking management, single-point mission data file and mission report loading/unloading, and NVG compatibility, GPS/INS usage and others. HEWS is supported on ground by the HEWS EW support station that facilitates pre-mission data file preparation and post-mission data analysis via analysis/playback of recorded mission events and/or RF pulse data on a digital geographical map installed in the analysis computer.

BAE SYSTEMS

Echidna Phase 2A EWSP/SIIDAS

The Echidna Phase 2A project comprises airborne EW self-protection (EWSP) systems for Chinook and Black Hawk helicopters and C-130 aircraft, along with pre- and post-mission support facilities for the Joint EW Operational Support Unit and mission planning and training systems. The EWSP suite, also known as the Sensor Independent Integrated Defensive Aids Suite, includes an EW controller, radar warning, MWS and CMDS. The ALR-2002 functions as an RWR and EW controller. The system provides protection from RF and IR threats, and situational awareness for helicopter crews. The mission data system enables crews to plan EW missions at an operational base as well as conduct post-mission analysis and mission replay. The integrated EW mission support system further enhances the adaptability of the Echidna EWSP to meet current and future needs, says BAE Systems. The system can be extended with additional sensors and countermeasures.

HeliDAS

Suite of self-defence equipment for helicopters. It includes single-point cockpit control, IR jammer alternatives, multiple MAW system choices, lightweight dispensers, cost-effective radar warning alternatives and growth options to laser warning. All elements are in production and have been previously exported and installed.

BIRD AEROSYSTEMS

AMPS/AMPS-MV

The Airborne Missile Protection System (AMPS) family of products – developed in cooperation with Airbus Defence and Space – is a third-generation self-protection system that protects against MANPADS and other missile threats. The system automatically detects the missile threat, processes and optimises the countermeasure solutions, either chaff and flares or DIRCM, while providing visual and audio alerts to the crew. The product is officially certified by several aircraft manufacturers, including Mil Moscow Helicopter Plant for integration on the Mi-8/17, including the appropriate service bulletin for the installation on several types of Mi-8/17s. The AMPS is the UN Air Operations and

NATO standard system selected and installed by many NATO armed forces (Australia, Czech Republic, France, Germany, Italy and others). According to the company, the product is the only known system to successfully protect against the latest generation of MANPADS (SA-24) during combat operations (in Libya). AMPS has been installed on over 400 civil and military aircraft including Mi-8/17s (several types), H135/145/155/225s, BK 117s, Cougars, UH-60s, UH-1s, S-92s, CH-53s, Bell 407/212/412s, King Air 200/350ERs, P-3Cs, C-130s and others. As part of the AMPS family, Bird and Airbus DS are now offering the AMPS-MV (Missile Verification) configuration, designed to detect, verify, identify and foil MANPADS attacks while reducing the false alarm rate to 'practically zero'. By doing so, AMPS-MV complies with the EASA/FAA civil aviation regulations, enhances the system cost-effectiveness and its countermeasure capabilities. It is installed in over 2,000 aircraft.

SPREOS

Bird Aerosystems unveiled a new radar-based sensor/DIRCM system, the Self-Protection Radar EO System (SPREOS), at Eurosatory 2016. The single-LRU system provides protection against IR missiles including those fired by MANPADS. It is intended for a range of airborne platforms, including helicopters and large transport aircraft. As soon as a warning is received from the onboard MWS, SPREOS pivots in the direction of the incoming threat and activates the dual-band radar function for confirmation and tracking, which are performed simultaneously on both frequencies. High-precision tracking is achieved using millimetric-wave frequencies. SPREOS then deploys the dual-band countermeasure laser, causing the missile to miss the aircraft. The system is a joint development with a large European company.

DTS

RWR

The RWR self-protection suite for helicopters and combat aircraft against radar-controlled threats is are designed to protect fighter aircraft, transport aircraft and helicopters of the latest weapon systems controlled by radar. RWR have an angular coverage 360° around the aircraft. There are three coverage option frequencies: 6-18GHz, 2-18GHz and 0.5-18GHz. Frequency coverage: 2-18GHz (0.5-2GHz optional) Systems integrated: radio frequency unit, processing unit and CDU. DMA 106 has an omnidirectional antenna and a receiver for instantaneous frequency measurement (IFM). Includes interfaces for integration with other active and passive EW. Operating platforms: RWR DMA-105, RWR DMA-106

EKRAN RESEARCH INSTITUTE

President-S

President-S is a self-protection system intended for both helicopters and fixed-wing aircraft. The basic package consists of an electronic control unit, an RWR, an LWR, a MAW system and a CMDS. Options include active RF countermeasures, DIRCM and an advanced airborne expendable decoy. The active RF jammer is described as a new-generation system that uses DSP and countermeasure techniques that are based on DRFM technology. It protects the aircraft in a complex radar environment in the presence of simultaneous radar threats, and can be integrated into new-build and upgraded aircraft and located either inside the fuselage or in a pod. President-S expendable jammers are offered to protect aircraft from radar-guided missiles in both forward and rear hemispheres. Power: Built-in power supply Weight: 0.5kg Frequency coverage: S-band Gain: Up to 2W with 50-60dB of gain, operating for up to 6s

ELBIT SYSTEMS EW & SIGINT – ELISRA

All-in-Small

All-in-Small is an SPS designed for use in military and commercial fixed-wing aircraft and helicopters. The integrated EW suite comprises an EW controller, digital RWR, IR MWS, laser warning system and a chaff/flare dispensing system. The compact, lightweight system has a modular and open architecture with multiple interface ability. The suite can be optimally integrated with DIRCM, due to its high range detection, high DF accuracy and fast handover from IR passive approach warner to DIRCM. All-in-Small can be provided with IR-centric, multi-spectral emitter geo-location and net-centric capabilities. Weight: 7kg

ASPS

The Advanced Self Protection System (ASPS) includes both passive and active subsystems, and incorporates (for the first time for an F-16) both full azimuth coverage RWR and passive (EO) MWS. The system can detect pulse, CW, high-PRF and pulse-Doppler signals, discriminate them from interference and prioritise the most threatening ones. The system points at a valid threat by both visual and audible means. The MWS can also track a threat throughout the engagement. After detecting a missile threat by its IR signature, it filters the background clutter by a narrow spectral window optimised to real-time signal by an adaptive threshold. The threat assessment is determined by a target algorithm, which tracks each threat frame by frame, analyses target manoeuvrability, relative position, inertial data and angular velocity and intensity. The system includes digital receivers, DF, high POI, high sensitivity, fast reaction time, voice alarm, frequency measurement and automatic recording of emitter data. Coverage: low-band to Ku; spherical coverage Systems integrated: RWR (SPS-3000), ECM jammer (SPJ-40), MWS (PAWS) and CFDS

SPS-65(V)3

The SPS-65(V)3 radar and laser warning system is designed for use on helicopters and transport aircraft. It integrates RWR which detects all CW, high-PRF, low-ERP radars and laser sensors. Features: DF, high POI, high sensitivity, fast reaction time, audio alarm, frequency measurement, interface with chaff/flare dispensers and automatic recording of emitter data. Weight: 16kg Reception coverage: 360° Frequency coverage: low-band to 18GHz

SPS-65(V)5

The radar and laser SPS integrates a suite controller with digital RWR that detects all CW, high-PRF, low-ERP radars, MWS and (embedded) multi-band laser sensors or (external) LWS system. It has provision for (embedded or external) CFDS and ECM. Features: wide- and narrow-band digital receivers, DF, high POI, high sensitivity, fast reaction time, voice alarm, frequency measurement and automatic recording of emitter data. Length:

2.14m Width: 1.24m Height: 1.94m Power: 28V DC (MIL-STD-704) Weight: 11kg Reception coverage: 360° Frequency coverage: low-band to 18GHz

ELETTRONICA

ALR-733 family

The ALR-733 family of ESM systems is designed to provide surveillance, ELINT-type signal analysis and data collection for post-mission analysis, while securing RWR functionality. The ALR-733 family modular design (different antenna configuration and optional modules) can provide full RWR capability, fully automatic ESM surveillance (for situational awareness), computer-aided ELINT-type analysis under operator control and data collection capability for post-mission analysis. Applications: maritime patrol applications and AEW&C missions Operating platforms: ATR-42, NH90 NFH, EH101, Embraer 145

ELT/741 Family

The ELT/741 family of ESM systems is designed to provide surveillance, signal analysis and data collection while securing RWR functionality. It includes versions for airborne and naval applications. It integrates ECM, laser warning systems, chaff/flare dispensers, MWS and DIRCM. With digital elaboration performance and network-centric operations functions in a one-box configuration, it fulfils the operational requirements of situational awareness, maritime patrol and law enforcement applications. Some versions of this family are on board AW101, ATR-42, C-27J, Embraer 145, Falcon 20 and NH90 aircraft.

ELT/819

The ELT/819 family of ELINT/SIGINT Systems is Elettronica's latest product line for SIGINT, with versions for airborne and surface platforms. These products are based on digital architecture, representing the integration of wideband and narrowband receivers to accomplish complex tasks, exploiting a limited number of scheduled resources and enabling interception and geographical location of fugitive emitters. The equipment is designed to be reconfigured with COMINT capability in multi-platform versions. Its digital receivers feature high sampling rate A/D converters, FPGA processors, spectral analysis and sensitivity. Basic configuration provides C-J frequency coverage, instantaneous bandwidth of 4GHz, a pair of digital receivers to grant high emitters discrimination and measurement accuracy. Enhanced configuration provides wider frequency band (down to B band and up to K band) and an instantaneous RF band up to 8GHz. Frequency coverage: C-J band (as option, coverage can be extended down to A band and up to K band)

ELT/950 EW Manager

The ELT/950 family performs various levels of coordination functions of EW sensors and actuators and includes versions for airborne, naval and ground applications. Installed on a single airborne platform, it performs as an EW manager integrating and controlling the self-protection system, collecting and integrating data from multiple sensors and coordinating countermeasures. A multi-spectral picture of the scenario is available to the crew/operator, improving the situation awareness, using on- and optionally off-board sensors. Applications: Improves EW capabilities in a network-centric environment and simultaneously resists cyber attacks/coordinates and exploits passive and active networked sensors and continuously checks network security.

Virgilius

Virgilius is an integrated, flexible EW architecture that exploits signal processing techniques and enabling technologies to achieve simultaneous ESM and multi-threat ECM operation through resource sharing and integrated management. DF and passive location are based on a digital measurement system. The small and light airborne version accomplishes both emitter detection, classification and identification as well as deceiving a large threat variety, including radar-controlled anti-aircraft artillery, SAMs, air-to-air missiles, early warning, search and modern multifunction radars of different classes of platforms. The naval version of the Virgilius is a solution developed for applications requiring a high-power transmitter on platforms from corvettes to frigates or aircraft carriers. The required ERP is provided through a different number of Rx/Tx modules, minimising requirements in terms of mass, dimensions and consumption, and facilitates its installation on any platform. It includes versions for ground applications. Applications: Integrated, flexible EW architecture Jamming coverage: multi-threat coverage against simultaneous threats Systems integrated: DF antennas, low band solid-state transmitters (C-D), medium-band active phased array transmitters (E-H), high-band active phased array transmitters (H-J)

EXTANT AEROSPACE

AN/ALE-47 + AN/AAR-47

Extant Aerospace has installed the AN/AAR-47 MWS and AN/ALE-47 CMDS on numerous fixed- and rotary-wing platforms for US government and export customers. More than 3,000 AN/ALE-47 systems have been installed. AN/AAR-47 systems have been installed on USN and USMC AH-1W/Z, UH-1N/Y, CH-53D/E, HH/SH/MH-60, P-3, C-130 and V-22 aircraft; USAF C-5, C-17, MH-53J, HH-60G, C-130E/H/J, HC-130N/P, A-10 and C-27J platforms; and US Army DHC-7s, MH-47Es and MH-60s. Other aircraft that feature the system include the S-61/SH-3, AH-6/MD 530, C-12, AW139, Bell 212/214/412, DHC-8, King Air 350, CN-235, BT-67 and Cessna 208.

HARRIS COMMUNICATION SYSTEMS

AN/ALQ-211

The AN/ALQ-211 family of EW self-protection systems offer modern digital receiver/DRFM-based integrated radar warning and jamming capabilities for multiple fixed-wing and rotary platforms. Capable of countering multiple, simultaneous threats including pulse, pulse-Doppler and CW, this module/scalable system has nine different configurations to provide mission enabling technologies for multiple airborne platforms. The system is designed to intercept, analyse and counter multiple air and ground RF threats including all modes of early warning, air defence, airborne interceptor and coastal and surface surveillance radars. The high-power pulse and CW EW transmitters provide robust countermeasure techniques and protection against monopulse, coherent and non-coherent radars. The AN/ALQ-211 fuses multispectral (RF, IR, laser) sensor threat data providing the crew with an unambiguous threat assessment of

the battlespace. The system is in full-rate production and is offered with comprehensive US government mission data and operational software support through US FMS. Applications: Provides aircrews with multispectral situation awareness, threat warning and ECM Operating platforms: Full-rate production for US military applications, international F-16s as well as an RWR/ESM variant is used on NH90 for maritime patrol application

AN/ALQ-214 IDECM RFCM

The ALQ-214 Integrated Defensive Electronic Countermeasures RF Countermeasures (IDECM RFCM) subsystem comprises an onboard technique generator developed by Harris integrated with an offboard fibre-optic towed decoy. The ALQ-214 supports autonomous operation in hostile environments. The system is designed to counter RF-guided threats with ECM techniques. Threats are identified, prioritised, countered and displayed to the operator by the modular, software-reprogrammable system. The ALQ-214 will provide self-protection capabilities for the USN F/A-18C/D and E/F Super Hornet well into the future. In August 2015, Harris was awarded a contract worth $97 million to supply the USN with AN/ALQ-214(V)4 jammers to equip F/A-18C/D and F/A-18E/F aircraft. The system is also installed on Royal Australian Air Force F/A-18 aircraft. On 16 October 2017, it was announced that Harris received a $133 million contract to supply electronic jammers to protect USN and Royal Australian Air Force F/A-18 Hornet and Super Hornet aircraft against electronic threats. Under the contract, Harris will manufacture and deliver ALQ-214(V)4/5 IDECM jammers for the C/D/E/F variants. Deliveries are expected to be complete by May 2020. Weight: 129kg

IAI ELTA SYSTEMS

ELL-8260/2 INEW SPS

The ELL-8260/2 is an integrated self-protection suite for helicopters against surface-to-air and air-to-air weapons. It consists of a central processor, an RWR, an LWR, a MAW and a chaff/flare dispenser. Once threats have been identified, countermeasures are activated according to programmed pre-flight messages. It identifies pulse, CW and other exotic threats in a short cycle time and beyond that their lethality envelopes. It can record data on unknown signals to feed ELINT systems and is reprogrammable in the field. The chaff/flare dispenser supports operational modes including automatic, semi-automatic and manual with up to 16 separate firing programs. The MAW is an advanced solid-state pulse-Doppler radar. The laser warner detects rangefinders, illuminators and beam riders and is immune to EM and solar interference. Coverage: 360° Systems integrated: Radar warning receiver, chaff and flare dispenser, missile approach warning system and laser warning receiver.

ELL-8427/8 Integral Compact EW Suite/RWJS

The RWJS is flight-line reprogrammable. Using PC-based equipment and user-friendly human-machine interface, threats and jamming EW techniques can be updated. Due to its small dimensions and flexibility, the RWJS interface can be integrated with an airborne platform's avionics, including Chaff and Flares Dispenser, Missile Warning System, Laser Warning System, Towed RF Decoy and Multi-Function Display. Including the Exciter and ESM Receiver, these compact systems are able to protect an airborne platform from existing regular and modern threats to future threats (Air-to-Air and Surface-to-Air). These self-protection suites, marketed as Radar Warning and Jamming Systems (RWJS), share the same hardware and software for executing RWR and jammer missions. ELTA's EL/L-8247/8 Integral Self Protection Suites aim to be compact, modern, advanced and cost-effective. The systems are designed to enhance the survivability of fighters, helicopters and other military aircraft by suppressing multiple threats in dense radar-guided weapon systems environments. Hundreds of ELTA's Self-Protection Systems are deployed in Israel and worldwide on Western and Eastern military airborne platforms. The RWJS incorporates modern architecture and advanced technologies based on ELTA's field proven experience of more than 30 years in design and manufacturing of EW Systems and based on operational feedback. Weight: 17-30kg Operating platforms: Internally installed on board fighter aircraft, helicopters and other military aircraft Jamming coverage: 360° for radar warning and jamming for front and aft sectors Systems integrated: RWJS central unit, transmitters, receiving antennas, front-end antennas, transmitting antennas

IMI SYSTEMS

Airmor

Airmor is an autonomous modular countermeasure SPS designed for helicopters and transport aircraft. Airmor's core components are IMI's management control unit (MCU), which processes information from EW sensors and the aircraft avionics, generating an optimal response to a particular threat; a control and display unit (CDU), which provides situational awareness, as well as controls for operating the system. A typical Airmor suite set-up will also employ a passive UV MWS sensor and a CMDS with various expendables. Additional components such as radar, laser warning systems and DIRCM can be integrated. MIL Standards: MIL-STD-1553B, S422, ARINC 429 interfaces Operating platforms: helicopters and transport aircraft Systems integrated: control display unit, missile warning sensor, countermeasure dispensing system; plus optional RWR, laser warning sensor and DIRCM

LEONARDO AIRBORNE & SPACE SYSTEMS

AGP

See entry in Chaff, flare and decoy systems subsection

HIDAS

The Helicopter Integrated Defensive Aids System (HIDAS) combines an RWR/LWR, MWS and chaff and flares. It is fitted to UK RAF Chinook and Puma helicopters as well as UK and exported Apache helicopters. Using multispectral sensors and pre-loaded intelligence to produce tactical pictures of the operational environment, HIDAS identifies hostile systems and initiates countermeasures. At the core of HIDAS is a smart suite controller. This allows configuration to meet the requirements of helicopter platforms through scaling the sensor capability and incorporating appropriate countermeasure systems.

HIDAS-15

The Helicopter Integrated Defensive Aids System 15 (HIDAS-15) is a variant of the HIDAS (see separate

The AN/ALQ-214 system is designed to counter RF-guided threats with ECM techniques. (Image: Harris)

entry) developed by Leonardo for the AW159. Standard components of HIDAS-15 comprise a radar warning receiver, defensive aids system controller, missile warning system and countermeasures dispensing system. For the naval variant of the AW159, the RWR provides a basic surveillance function. If a more capable ESM is required, the modular nature of the HIDAS-15 provides ease of integration. The HIDAS-15 is supported by a mission data generator (MDG) for electronic warfare operational support. The MDG provides trained users with a facility to construct theatre-specific MDS with sovereign EW data. Operating platforms: British Army battlefield reconnaissance helicopter and UK RN surface combatant maritime rotorcraft variants of the AW159 Wildcat

SAGE

SAGE is a digital ESM for RF ISR missions. Delivering a situational awareness capability, it provides RF signal analysis for intelligence assessment and tactical decision-making. It affords both single and multi-platform geo-location of RF assets, and uses parallel wideband and channelised receivers to deliver detection and analysis. SAGE is suitable for a range of air platforms, from tactical UAVs and light helicopters to larger reconnaissance and maritime patrol aircraft.

MBDA

SAPHIR-M / ELIPS-NH

See entry in Chaff, flare and decoy systems subsection

NORTHROP GRUMMAN

SISCM

The Suite of Integrated Sensors and Countermeasures (SISCM) is designed to provide an integrated, multi-sensor threat warning and countermeasures capability using off-the-shelf technology for helicopters and tilt-rotor aircraft. All subsystems are controlled by the APR-39B(V)2 EW management system, which also fuses data from other aircraft sensors and systems such as INS, GPS and radar. The SISCM records threat and GPS data for post-mission analysis and planning. Compatible subsystems include multiple UV and IR MAWs, Nemesis family DIRCM turrets, the AN/ALQ-162(V)6 radar jammer, the AN/ALE-47 CMDS and LWRs such as the 301-MA and AVR-2/2A. The ALQ-213 EW management system can also be used. Operating platforms: AH-1W, AH-1Z, AH-64D, CH-47D, CH-47SD, CH-53, Cougar, HH-60G/H, MH-53, MH-60S, MV-22B, S-70, UH-1N, UH-1Y, VH-3, VH-60

RAFAEL ADVANCED DEFENSE SYSTEMS

Helistar

A cooperative development between Cassidian Electronics (now Airbus) and Rafael, Helistar combines the AN/AAR-60 MILDS MAW with Rafael's Jam Air DIRCM system, a signal processing unit and interfaces to visual and audio displays. The UV missile detector/approach warner offers a low false-alarm rate, as well as being passive in operation. It is designed to identify the correct countermeasures response and handle multiple, simultaneous threats.

SAAB

IDAS

The Integrated Defensive Aids Suite (IDAS) is a family that includes CIDAS 100 and IDAS-3, which provide multispectral radar, laser and missile warning with automatic countermeasures dispensing. CIDAS 100 is the small, lightweight variant with EO sensors only and a smaller control unit. It is designed to protect against MANPADS and laser-based threats. IDAS-3 is a high-end system with full multispectral detection capability for radar including an optional digital receiver and MAW. Both are integrated with Saab's BOP-L lightweight dispenser. The modular architecture is flexible, offers a low box count but a large number of industry-standard interfaces, easing installation in helicopters, transport aircraft and fighters. It offers post-mission playback and analysis via a flight data analyser and an EW data management system. IDAS is installed on multiple helicopters, transport and fighter aircraft worldwide. Operating platforms: Oryx, Puma, Cougar/Super Puma, Rooivalk, A109, Super Lynx, Dhruv, CH-47, NH90, Mi-17

TERMA

3D-Audio and ANR

It is designed for the acoustic environment found in most military aircraft. The system, which is operational and fielded in F-16 fighter aircraft, is designed as a form-fit replacement of the existing intercom system, including the amplifier and headset. It can be adapted to other platforms, as proven during an A-10 ground attack aircraft flight test. Reduced noise level through ANR and electrical noise filtering means less stress and fatigue for pilots and other crew members, especially during prolonged missions, and the reduced noise level also allows pilots to reduce the volume of the intercom system. 3D-Audio is used in two ways to improve the quality of the audio messages presented to the pilot. First, it allows spatial separation of messages (eg cues, VHF/UHF radio communication, warnings, intercom). Because the messages are directional in the pilot's earphones, it allows the pilot to focus on the most relevant, while they are still kept aware of other messages. 3D-Audio is especially useful when it comes to threat warnings. Not only does

the pilot receive the warning from the exact direction of the threat, but will also, unlike traditional voice message system, be able to initiate evasive manoeuvres more than a second earlier, because the pilot can act instinctively without the need to process any information mentally. On 19 February 2018, Terma North America received a contract from the US Air National Guard/Air Force Reserve (ANG/AFRC) to provide a 3D-Audio System for their F-16 aircraft. Work under the $44.3 million indefinite-delivery/ indefinite-quantity contract will be performed by the company at its facilities in Denmark, and is expected to be complete by January 2024.

ACMDS

The Advanced Countermeasures Dispenser System (ACMDS) is designed to coordinate, integrate and operate expendable countermeasure payloads on fixed-wing fighter, transport and wide-body aircraft as well as helicopters. The ACMDS dispenser suite is controlled via an AN/ALQ-213 EW Management Unit (EWMU) or defensive aids controller (DAC), which provides a reprogramming interface, automatic decision support for the pilot in a threat environment, built-in training capability, and full EW suite control, if desired. The ACMDS components consists of a series of autonomous LRUs that includes a digital sequencer switch, an EM interference filter/safety switch and a number of dispenser assemblies. In addition to the standard air force dispenser assemblies, its components have been integrated in applied aerostructures as both scab-on, pylon-mounted and podded solutions, such as F-16 PIDS, MASE and MCP. The ACMDS system has been combat proven through operational service for more than 25 years with a demonstrated mean time between failure value of >18,000h. Features include form-fit compatible with legacy Terma and third-party dispenser systems, in-country organic reprogrammable, payload dispensing based on payload age/flight hours, intelligent squib interface for support of multi-shot cartridges and expendable active decoys, mixed payload capability, simultaneous dispense of multiple payloads, platform-adaptable hardware-controlled safety features, configurable back-up mode allowing smart dispensing without ACMDS controller, programmable firing characteristics supporting smart and multi-shot payloads, synchronous and asynchronous dispense patterns and field reprogrammable by end user. The ACMDS suite includes ground support equipment (dispenser test adaptors, payload simulator and stray voltage tester), and dispense programme analyser as well as a Windows PC-based EW Mission Support Tool application for field/in-country organic mission data generation and post-flight analysis.

AMASE

Apache Modular Aircraft Survivability Equipment (AMASE) is a podded suite developed for RNLAF Apache attack helicopters. Each helicopter has two pods mounted on the stub wings, both holding two chaff/flare magazines and three UV-based missile warning sensors providing 360° spherical coverage against incoming threats. Each AMASE pod can house a DIRCM unit. The AMASE system includes the Terma-developed AN/ALQ-213(V) computer-based integrated EW management system.

AN/ALQ-213(V) DAC

The ALQ-213(V) Defensive Aids Controller (DAC) is small, lightweight and features configurable interfaces. The system allows for the selection of a number of functions – automatic threat reaction/decision support algorithms and embedded training function are user-programmable. The DAC typically integrates a number of IR/RF sensors and countermeasures, for example via one or more MIL-STD-1553B buses and/or Gigabit Ethernet in combination with discrete and digital interfaces. Depending on the application, the DAC may integrate cockpit MFDs as applicable or provide graphical user interaction via Terma's Advanced Threat Display. Length: 17cm Width: 15cm Height: 10cm Power: 28V DC Weight: 1.6kg

AN/ALQ-213(V) EWMS

The EW Management System (EWMS) is designed for combat aircraft, transports and helicopters, replacing individual control and display units with a management unit, a new MFD and PCMCIA data loading/recording/ unloading. It incorporates 3D audio threat warning, radio channel separation and active noise reduction. HOTAS control of manual semi-automatic or automatic modes is offered. EWMS can automatically initiate the optimal combination of chaff, flares and jamming. Terma's ALQ-213(V) Defensive Aids Controller offers a non-ITAR controller solution for military EW self-protection suites. It belongs to Terma's family of controllers, in service on more than 2,000 aircraft. It offers a small form-factor platform for integration of sensor and countermeasure systems as well as aircraft core functions with its configurable interfaces. The Terma integrated EW SPS allows for selection of functions for optimisation of performance through automatic threat reaction/decision support algorithms and an embedded training – all user-programmable. The DAC typically integrates a number of IR/RF sensors and countermeasures, for example via one or more MIL-STD-1553B buses and/or Gigabit Ethernet in combination with discrete and digital interfaces. Depending on the application, the DAC may integrate cockpit MFDs as applicable or provide graphical user interaction via Terma's Advanced Threat Display. Length: 17cm Width: 15cm Height: 10cm Power: 28V DC, 40W max Weight: 2kg Operating platforms: selected for CH-47D/F Chinook (Netherlands, Canada), AH-64D Apache and AS532 Cougar (Netherlands), AS550 Fennec and AW101 (Denmark), Mi-17 and Mi-24 (Poland)

ATD

The Advanced Threat Display (ATD) is a 3ATI dedicated self-protection display with the capability of providing a real-time correlated threat environment picture. The ATD option select buttons on the front bezel make the display a single-point control panel for the operation of the entire self-protection suite of subsystems, providing an intuitive user interface to the pilot. Different page views can be selected by the user in order to format the requested data and present views for each operational mode. The display is based on LCD technology, is sunlight-readable and provides night vision capabilities. The ATD design is based on a modular concept allowing for a family of configurations with different data interfaces and front bezels to accommodate installation in specific cockpit environments. Baseline design of the ATD utilises PowerPC controller design for display functions. The ATD interface allows for operation either as standard display (digital video from external source), as intelligent display with only data interface to external world, or even as controller, for example a chaff/flare dispenser and a missile warning system. Power: 28V DC Weight: 1.2kg Dimensions: 200x154x88mm MIL Standards: MIL-STD-1553B

Universal DIRCM Pod

Terma provides universal pods for DIRCM installations as a role-fit solution for a range of fixed- and rotary-wing platforms. The pods house the complete DIRCM suite, including turret, electronics, and MWS sensors in a small, lightweight and rigid structure. An installation comprises two pods; one on each side of the aircraft. Pods are used on aircraft with hardpoints for external stores, and scab-on variants with different fairings on aircraft with no hardpoints that instead use custom adapter structures for installation. The podded solution permits precise and rigid sensor fits compared to federated installations with distributed sensors. Sensor alignment actions are eliminated and sensitivity to airframe deflection is minimised, it is claimed. The open architecture is compatible with DIRCMs-capable UVs or IR MWS which facilitates flexible options for standalone installations or as part of an aircraft survivability system. Length: 950mm Width: 300mm Height: 340mm Weight: 15kg

THALES

CATS for Helicopters

The Compact Airborne Threat Surveyor (CATS) for helicopters provides electronic situational awareness and self-protection for a range of military helicopters in a lightweight unit. It provides real-time detection of multiple simultaneous air defence threats through its RWR and can also be installed on fixed-wing aircraft and UAVs. Its main features include 100% POI from its sensitive RWR, automatic and instantaneous threat identification due to its user-programmable threat library and data recording. The cockpit display is NVG-compatible. The SPS processor manages radar, laser and MAW systems, as well as chaff/flare dispensers and jammers, optimising countermeasures employment. Data can be transmitted to cooperating platforms. The system includes mission planning, training and support tools, and an onboard training capability. Length: 19cm Width: 16cm Height: 32cm Power: <125W Weight: <10kg Coverage: 360° in azimuth, +/-45° elevation, >10° accuracy MTBF: 700h Frequency coverage: E-K (C-D band option)

SPS-H/TA/FA

Family of lightweight and modular SPS for helicopter (H), transport aircraft (TA) and fighter aircraft (FA). Integrates TDS family RWR, MWS-20 MAW, chaff/flare dispenser and optional LWR. SPS-H provides helicopters with a dedicated SPS. The system allows early detection of threats and provides the crew with full EW situational awareness, to avoid hostile weapons sites. Acting as a 'switch-on and forget system', the SPS-H V1 requires no crew action thus reducing stress and workload. SPS-H V2 is claimed to be a comprehensive system to provide enhanced EW situational awareness and self-protection. The core system includes SPS system processing, TDS-H RWR, an MWS-20 H missile approach warner and chaff/flare dispensers. Optional equipment includes various types of LWRs and an interface for optional IR and/or RF jammers.

TWE

Threat Warning Equipment (TWE) is a lightweight integrated SPS based on an RWR from Thales Airborne Systems linked to a laser warner, manufactured by Airbus Defence & Space. Provides interfaces to subsystems such as chaff/flare dispensers. Sensor data is correlated and evaluated through a programmable threat library. The TWE has been selected for Tiger attack and NH90 transport/naval helicopters. It offers user-programmable threat library and symbology, and provides flight reports for tactical ELINT. Power: 200W Weight: <15kg Frequency coverage: E-K bands MIL Standards: MIL-STD-1553B

TOKYO KEIKI

HLR-108

A Japanese ESM system installed in Japan Maritime Self-Defense Force SH-60J Seahawks. The HLR-108B/C are upgraded versions. Operating platforms: Japan Maritime Self-Defense Force SH-60J Seahawks

IR JAMMERS

BAE SYSTEMS

AN/ALQ-144A

The AN/ALQ-144A is a family of IR jammers for helicopters using a heated and modulated graphite IR source. ALQ-144A variants offered as upgrades to older 'Basic' and 'VE' units. ALQ-144A(V)1 is standard version; (V)3 adds an on/off switch for RF countermeasures; (V)5 is a dual phase-locked (V)1 with a jam code selector switch; ALQ-144A+ is a more powerful version of the (V)1; and ALQ-144A+(5) is a more powerful version of dual phase-locked A+. Length: 32cm Width: 34cm Height: 32cm Power: 1,650W Weight: <14kg FOV / azimuth coverage: 360°

AN/ALQ-157

The AN/ALQ-157 is an IR jammer for transport aircraft and large helicopters against Band I, II and II IR missiles. More than 900 AN/ALQ-157 type systems have been delivered to support eight different aircraft types. The system comprises an IR lamp-based transmitter, control power supply, EM interference filter assembly and aircrew control indicator. Inflight selection of five pre-programmed jamming codes is offered. Weight: 100kg

AN/ALQ-212 ATIRCM

The AN/ALQ-212 Advanced Threat Infrared Countermeasures (ATIRCM) DIRCM suite provides passive warning of missile approach using the AN/AAR-57 MWS, which detects the missile, rejects any false alarms and cues the onboard IR jamming system's jam head to the missile's location. When the jam head finds the missile, it emits a high-energy beam of IR energy to defeat the missile's seeker. The AN/ALQ-212(V) incorporates one or more IR jam heads to counter multiple attacks. It has been installed on US Army helicopters and fixed-wing aircraft. In October 2004, BAE Systems was awarded a $484 million contract for the supply of up to 484 ALQ-212s to the US Army.

ELBIT SYSTEMS INTELLIGENCE AND ELECTRO-OPTICS – ELOP

MUSIC

Elbit Systems' MUSIC (Multi-Spectral Infrared Countermeasure) family of airborne DIRCM jammers is produced in three versions: MUSIC, J-MUSIC and C-MUSIC, the latter for large jet aircraft. The product

line is designed to protect an aircraft against IR-guided missiles. C-MUSIC was selected by the government of Israel to protect the Israeli commercial fleet. MUSIC is designed to protect helicopters and fixed-wing aircraft. Using a modular architecture, it is designed to work alongside existing aircraft self-defence systems. It can be fitted to an aircraft in a single, dual or multi-turret configuration, and can be used with an external missile approach warning system (MAWS). C-MUSIC is equipped with an integrated MAWS. It can be mounted on board an aircraft in either a pod or distributed configuration. J-MUSIC, meanwhile, is intended to protect small and medium-sized jet aircraft, including civilian platforms such as business jets and freighters. The system can be integrated with a MAWS. The J-MUSIC architecture includes a thermal camera for the acquisition and tracking of the incoming missile, laser generator and laser head to produce laser light intended to blind the missile, a high-speed mirror to direct the laser light and a systems processor. J-MUSIC can be installed onto an aircraft in a single, dual or multi-turret configuration. In November 2014, Elbit Systems announced that it had been awarded a contract by Diehl BGT Defence to install its J-MUSIC product on board the German Air Force's Airbus A400M transports. Installation of this product on board these aircraft was expected to be completed by the end of 2016. Elbit has recently a two-year $26.5 million contract with an unnamed customer in the Asia-Pacific region to supply its C-MUSIC system for integration on a wide-body jet aircraft. Length: 27cm (MUSIC), 270cm (C-MUSIC) Width: 27cm (MUSIC), 60cm (C-MUSIC) Height: 18cm (MUSIC), 50cm (C-MUSIC) Power: 1,200W (MUSIC), 3,000W (C-MUSIC) Weight: 45kg (MUSIC), 160kg (C-MUSIC)

ELETTRONICA

ELT/572

The ELT/572 DIRCM system uses fibre laser technology for high modularity, flexibility, reliability, extended lifetime, intrinsic growth capacity and maintenance-free operation, claims the company. The ELT/572 typically consists of a jamming turret, a laser generator and an electronics unit. It is compact and lightweight with a fixed dome, isolating the moving parts from the airstream, allowing a high slew speed that shortens reaction time. The system is modular and designed to counter multiple threats and is 'easy to install' on all types of aircraft, rotary- or fixed-wing, according to the company.

LEONARDO AIRBORNE & SPACE SYSTEMS

Miysis

The Miysis DIRCM system is the latest generation DIRCM from Leonardo. It is exportable and suitable for use on air platforms from small helicopters to large, wide-bodied transports and has been designed to address the requirements for next-generation DIRCM systems. Weighing under 40kg, excluding the Missile Approach Warner Sub-system (MAWS), Miysis is the smallest and lightest multi-turret, full coverage DIRCM system available. It also has the lowest power requirement of any full-coverage system, claims the company. Miysis is designed for ease of manufacture and repair, and it offers reduced through-life cost in comparison to previous generations. The installation of the system can be tailored for individual customer and platform requirements. Length: 27cm Width: 18cm Height: 34cm Power: 190W typical, 535W max Weight: 16kg

NORTHROP GRUMMAN

AN/AAQ-24(V) Nemesis

The Nemesis is a UK/US DIRCM system for fixed-wing aircraft and helicopters for protection from IR missiles. It integrates warning, tracking and jamming functions. AN/AAR-54 passively detects missile plume energy, tracks multiple energy sources and classifies each as a lethal missile, non-lethal missile or clutter. Turret formats are optimised for helicopter or fixed-wing applications. Multiple turrets can be used on large aircraft. Operating platforms: fixed-wing aircraft and helicopters

CIRCM

Common Infrared Countermeasures (CIRCM) is a laser-based DIRCM system for helicopters and small fixed-wing aircraft developed by Northrop Grumman and partner Leonardo based on the former company's Viper Spell DIRCM laser. CIRCM is a production-ready, open-architecture system designed to work with existing missile warners and countermeasures dispensers, simplify upgrades and keep life-cycle costs low. In August 2015, the US Army awarded Northrop Grumman $35 million contract options for engineering and manufacturing development and low-rate initial production of CIRCM.

Viper Mid-IR Laser

Modular all-band laser for IRCM applications developed by Northrop Grumman for the DIRCM family. According to the company, it is capable of jamming 'virtually all fielded IR missiles'. Height: 5.08cm Power: 320W Weight: <4.54kg Operating platforms: selected for CV-22 tiltrotor and Australian Wedgetail AEW aircraft

RAFAEL ADVANCED DEFENSE SYSTEMS

Jam-Air

DIRCM and missile warning system, directing high-power jamming energy against all IR-guided missiles. Designed for helicopters, Jam-Air features a fast and accurate dual-axis EO jamming lamp. Proven and unmatched operational effectiveness are claimed. It is software-based to ease upgrades to cope with more advanced threats. An optional tracking unit provides real-time assessment of countermeasure effectiveness. Jam-Air can function as a standalone system or be combined with chaff and flare dispensers and laser or radar warning receivers. Jamming Cycles Without Maintenance (Number of): >1,000

RAYTHEON

Quiet Eyes

Quiet Eyes is a laser DIRCM system, a pointer/tracker turret that protects aircraft from IR-guided missiles by jamming and away from the target. The DIRCM system consists of the missile warning system and a laser-pointed tracker. The warner identifies any IR missile threat heading for the platform. The turret finds the IR missile threat, acquires it, tracks it and, through an optical fibre connected to a telescope inside the turret dome, transfers laser energy to defeat the missile. Operating platforms: integrated with BAE Systems' ATIRCM MAW on US Army UH-60 Black Hawks

The AN/AAR-47 EW system is designed to protect aircraft against IR-guided missiles, laser-guided threats and unguided munitions. (Image: Orbital ATK Defense Electronic Systems)

THALES

Flash

The Flying Laser Self-Defence System Against Seeker Head Missiles (FLASH) is a DIRCM system for protecting helicopters and fixed-wing aircraft against missiles with IR seekers. The dual-laser system provides protection against commonly deployed IR-seeking missiles, as well as current and future jam-resistant weapons. It offers multi-threat capability and missile target extraction.

LASER WARNING RECEIVERS

AIRBUS DEFENCE & SPACE (GERMANY)

ALTAS-2QB

The Advanced Laser Threat Alerting System – Two Quadrants with Beamrider detection (ALTAS-2QB) is a passive system designed to detect, track and warn of hostile laser sources aimed at the platform. Threats detected by the system include rangefinders, designators and solid-state beam riders, and it has the ability to track up to four threats. The system is designed for easy integration on all airborne military platforms. As a self-contained system it requires no separate processing unit. It also offers a low false-alarm rate, a short activation time and high angle-of-arrival resolution. The ALTAS-2QB is designed to be compatible with all DAS and delivers all parameters required to initiate countermeasures. Applications: LWS Length: 140mm Width: 240mm Height: 189mm Weight: 3.5kg FOV - Azimuth (Degrees): 182° FOV - Elevation (Degrees): +/- 45°

ELBIT SYSTEMS EW & SIGINT – ELISRA

LWS-20V-3

The LWS-20V-3 is a laser warning system for helicopters, transport and attack aircraft. The system is capable of detecting laser beam riders, laser rangefinders and laser target designators. Its high sensitivity (for LBR) and high POI provide the system with a long detection range and fast response time in dense arena scenarios. The system also supports onboard laser source blanking. Power: 28V DC (MIL-STD-704); consumption 120W Weight: 6.5kg MIL Standards: MIL-E-5400 Class I/B

ORBITAL ATK DEFENSE ELECTRONIC SYSTEMS

AN/AAR-47A(V)2

The AN/AAR-47A(V)2 Missile and Laser Warning System (MWS) is an EW aircraft survivability system designed to protect low and slow flying fixed- and rotary-wing aircraft against surface-to-surface/air missiles and laser-guided or aided threats. Upon detection of the threat, the MWS will automatically initiate countermeasures and provide an audio and visual warning to the pilot. The AAR-47 system consists of a computer processor, control indicator (CI) and four optical sensor converters. The MWS is designed to interface with an onboard radar warning set, a countermeasures dispensing set and either the CI provided or a multi-function, multi-purpose display. The sensor upgrade programme to the AAR-47 was designed to improve missile warning performance and incorporated laser warning functionality. The new missile warning sensor incorporates an additional internal detector into the widely fielded AAR-47(V)2 sensor. The upgrade was a USN-led joint programme with active USAF and USSOCOM participation. Power: 28V DC Weight: 13.6kg (combined)

AN/AAR-47B(V)2

The AN/AAR-47B Missile Warning System (MWS) is an EW system designed to protect low/slow-flying aircraft against surface-to-air and air-to-air missiles. The MWS will detect a missile fired at the aircraft or a laser pointed at the aircraft. Upon detection of the threat, the MWS will automatically initiate countermeasures by sending a command signal to the ALE-39, ALE-40 or ALE-47 Countermeasures Dispensing Set. The system supports US DoD and allied helicopters and transport/cargo type aircraft in various operational environments. Variants of the AAR-47 have been fielded on over 3,000 aircraft including the AH/UH-1, CH-46, CH/MH-47, CH-53, HH/MH/SH/UH-60, S-61, S-92, and Bell 214, 407 and 412 rotorcraft; as well as the P-3, C-5, DHC-7, DHC-8, MC/UC-12, C-17, MV-22, RC-26, C-27, BT-67, C/KC-130, AC-208 and Beech 1900 fixed-wing aircraft.

UTC AEROSPACE SYSTEMS - ISR SYSTEMS USA

AN/AVR-2A(V)

The AN/AVR-2A(V) is UTC-ISR Systems' laser warning system which detects, prioritises in order of lethality and

characterises laser rangefinders, laser designators and laser beam-riding missile threats. The system has been in production since 1995 and can be installed across a range of military helicopters, tanks and light armoured vehicles. Besides its key capabilities of multiple aircraft signal interfaces and detection, the system can also interface with the Multiple Integrated Laser Engagement System Air-to-Ground Engagement System II (MILES-AGES II), a training system that provides weapon engagement simulation for pilots. The US military has installed the AN/AVR-2A on its helicopters to provide them with audible and visual warnings, all-weather operation and 360° coverage. Length: 28.7cm (sensor unit); 21.6cm (interface unit) Width: 19.3cm (sensor unit); 13.9cm (interface unit) Height: 10.8cm (sensor unit); 15.2cm (interface unit) Power: 47.3W at 28 VDC (nominal) Weight: 2.3kg (sensor unit); 2.5kg (interface unit) MIL Standards: MIL-STD-1553B and RS-422 interface Operating platforms: AH-64A Apache, AH-64D Longbow Apache, MH-60K SOA Black Hawk, MH-47E SOAR Chinook, OH-58D Kiowa Warrior, HH-60H Combat Rescue, MV-22B Osprey, EH-101, WAH-64D, MH-60R, AH-1Z, UH-1Y

AN/AVR-2B(V)

UTC-ISR Systems' laser warning systems detect, prioritise in order of lethality, and characterise laser rangefinders, laser designators and laser beam-riding missile threats. They are designed for use in military helicopters, tanks and light armoured vehicles. The AN/AVR-2B(V) Laser Detecting Set provides audible and visual warnings, all-weather operation and threats detected over 360° coverage. In 2013, the US Army awarded UTC Aerospace Systems a five-year Indefinite Delivery, Indefinite Quantity contract worth up to $208.5 million for AN/AVR-2B(V) Laser Detecting Sets, associated parts and services. The AN/AVR-2B(V) is used across the army's combat helicopter fleet. To date, the company has delivered over 1,600 AN/AVR-2B(V) systems with a record of 89 months of on-time delivery. Length: 20.7cm (sensor unit); 12.7cm (signal comparator module) Width: 17.8cm (sensor unit); 17.8cm (signal comparator module) Height: 8cm (sensor unit); 14.7cm (signal comparator module) Power: 33W at 28VDC (nominal) Weight: 1.1kg (sensor unit); 1.8kg (signal comparator module) MIL Standards: MIL-STD-1553B and RS-422 interface Operating platforms: AH-64A Apache, AH-64D Longbow Apache, AH-64E Apache, UH-60A/L/M Black Hawk, MH-60K,L,M SOAR Black Hawk, MH-47D,E,F,G SOAR Chinook, OH-58D/F Kiowa Warrior, HH-60H Combat Rescue, MV-22B Osprey, EH-101, WAH-64D

MISSILE LAUNCH DETECTORS AND APPROACH WARNERS

BAE SYSTEMS

AN/AAR-57

The AAR-57 Common Missile Warning System (CMWS) consists of four or six missile warning sensors, depending on coverage around the aircraft, and an ECU. Sensors detect the launch and motor burn of an approaching missile, providing warning to the crew and automatically dispensing IR flares. It is also a missile warning subsystem for the AN/ALQ-212 ATIRCM/CMWS onboard IRCM system. The system has been fielded in over ten countries, and more than 2,000 units have been installed on over 30 platforms utilised by US and allied forces. In January 2014, BAE Systems announced that it had received a $39 million contract for more than 300 third-generation (Gen 3) CMWS units, which provide warning of small arms and RPG fire as well as new data recording capabilities for post-mission analysis. The order is the first part of a planned $500 million procurement that will see the Gen3 systems fielded to more than 1,000 army helicopters over 2014/2015. In-theatre installations have already begun on Apache, Kiowa Warrior and Black Hawk aircraft stationed in Afghanistan. In 2016, the UAE requested 46 AR-57 CMWS units as part of its AH-64E helicopter order. Length: 27cm Width: 23cm Height: 14cm Power: 350W Weight: 16kg for 6-sensor system

ELBIT SYSTEMS EW & SIGINT – ELISRA

PAWS

The PAWS family of IR-based passive warning systems provide a turnkey solution for airborne platforms including fixed and rotary, fast and slow, large and small, military and civilian, covering tactical, fighter utility, combat, tanker and VIP aircraft. The IR Missile Warning Systems (MWS) contribute to airborne platform survivability by providing advance warning of the presence of threatening missiles and by automatic management of applicable countermeasures onboard. Using high-frame-rate streaming IR imagery and signal processing, the systems detect and track incoming missiles, alert the aircrew with audio-visual warning signals, initiate flare dispensing and cue the DIRCM towards the approaching missile. PAWS operate either as standalone, self-contained systems or as part of a DAS. The systems are capable of providing threat information to other EW and avionics systems for centralised PVI/HMI management, as well as for enabling further threat handling. They are installed in a distributed configuration over the aircraft's skin, in a dedicated pod/bay or on a pylon. PAWS is in serial production and has been deployed on a variety of airborne platforms operated by Israeli and foreign customers worldwide. Platforms the PAWS family has been installed on to date include: AH-1, AH-64D, AW101, Bell 412, CH-47, Mi-8/17, Super Puma and UH-60, as well as the A1M, F-15, F-16, F/A-18, Boeing 737, BBJ, 747, 767, 777 and C-130B, C-130H, C-130J, CN235 and Il-76. In June 2017, the company was awarded a $20 million contract from an African-based customer to equip a VIP Gulfstream 650 aircraft with J-Music DIRCM systems that includes PAWS. Length: 145mm Width: 145mm Height: 260mm Power: 200W Weight: 20kg

PAWS-2

The Passive Airborne Warning System 2 (PAWS-2) is an IR MAW that uses image and signal processing to detect and track a missile's hot plume as it appears against the landscape surrounding the aircraft. By evaluating the missile's trajectory, PAWS-2 is able to discriminate between threatening and non-threatening missiles. When the system detects a threatening missile, it alerts the aircrew with a warning signal and activates countermeasures. PAWS-2 provides threat information to other EW systems as part of a suite as well as integrating with subsystems. The system can also

operate standalone. The Israeli Air Force has selected PAWS-2 to serve as the MAW system for its F-16I fighter aircraft. Main features of the system include: passive detection in the IR spectrum, sensitivity, 'optimal' clutter rejection, discrimination algorithm, automatic pilot warning, automatic activation of chaff/flare dispensing system and automatic cueing of DIRCM. PAWS-2 also incorporates real-time imaging, situational awareness and panoramic view and BIT. It also offers full spherical coverage and is effective against and can discriminate between MANPADS and AAMs. Length: 10cm Width: 10cm Height: 13cm Power: 200W Weight: 20kg

HENSOLDT SENSORS

AN/AAR-60 MILDS

Airbus Group developed the Missile Launch Detection System AN/AAR-60 (MILDS). It is a passive imaging sensor which detects and tracks the UV emissions of approaching missiles, including the prevalent use of heat-seeking shoulder-launched MANPADS. The MILDS system tracks and identifies UV sources through its imaging sensor, which determines the angle of attack and priority. The system then initiates proper countermeasures and warns the pilot to begin necessary evasive manoeuvres. The AN/AAR-60 is comprised of one to six identical sensor heads including optics, filters and imaging processing. The MILDS system's high spatial resolution and temporal processing capabilities increase the probability of detection while reducing the occurrence of false alarms. The high resolution enables rapid discrimination of stationary and moving UV point sources, enabling effective operations in both urban and battlefield environments. The MILDS missile warning system, on which AMPS is based, has been selected by customers across the world, including NATO. In total more than 7,000 sensors have been sold for platforms including the UH-60/SH-60, CH-47, CH-53, S-70, SH-3, Mi-8, Mi-17, Mi-171, NH-90, Tiger, P-3C, C-130, CN-235, VIP/HoS A340 and many others. Applications: Passive imaging MAW system Length: 12cm Width: 12cm Height: 12cm Power: 14W/h Weight: 2kg FOV - Conical: ±45° EL x 360° AZ Operating platforms: helicopters, transport aircraft and fighters MTBF: 9,600 flight hours

IAI ELTA SYSTEMS

ELM-2160V1

The ELM-2160(V1) is a radar-based airborne Missile Approach Warning (MAW) system that warns of an incoming missile attack to enable time for the activation of countermeasures to increase the platform's survivability. The countermeasures such as chaff and flares (C/F) are ejected by an advanced C/F dispenser for diverting the threat missile from its track and protecting the platform against a missile hit. The ELM-2160(V1) is a fully solid-state Pulse Doppler Radar that provides accurate calculated time to impact and measurement of incoming missile's direction. This data enables effective response for protecting the airborne platform. The system is field-proven and has been installed onboard military aircraft, helicopters, special mission aircraft and commercial aircraft. The MAW system can be integrated into a range of self-protection suits such as RWR and EO subsystems. They system also features capabilities such as the detection of any approaching missile type in boost, sustain and post burnout stages, it has all-weather capability, 360° coverage, low false alarm rate, accurate time to impact indication and optimal timing of C/F release for missile deception and extensive BIT and fault isolation capability. Length: 307mm Width: 239mm Height: 381mm Power: 350W Weight: 22kg

MS INSTRUMENTS

Hostile Fire Indicator Type 740

The Hostile Fire Indicator (HFI) Type 740 is a device which gives a warning to the pilot of a rotary-wing aircraft that they are under small arms fire, and indicates the general direction from which that fire originated. The system comprises a sensor array, computer unit and indicator together weighing under 6kg. The design of the equipment is based upon the detection of the shockwave front generated by a supersonic projectile. The system calculates the set of bullet velocity vectors which thus shows the direction of the source of the possible hostile fire. On receipt of an indication, the pilot would normally be able to take avoiding action and minimise the danger of a subsequent direct hit, the exact pilot action being dependent on the operational conditions prevailing. Although the standard unit is designed for rotary-wing aircraft, there is a more compact unit for attachment to ground-based vehicles. The Vehicle Hostile Fire Indicator (VHFI) may be attached to VIP cars or APCs. The VHFI system comprises the same basic units, however the sensor array is more compact and there may be multiple arrays fitted to vehicles with protruding parts. Power: 30W, 35W display illuminated Weight: <6kg Accuracy: responsive to supersonic projectiles with miss distances of up to 20m

NORTHROP GRUMMAN

AN/AAR-54(V)

The AN/AAR-54V is a fourth-generation MAWS which is currently in production and available for use on a range of platforms, including helicopters, fast jets and tactical and wide-body aircraft. The system provides clutter rejection, long range and short missile detection time, automatic cueing to the countermeasures system and situational awareness capabilities via HUD or RWR display. The AAR-54V passively detects UV energy from the missile's exhaust plume, tracks multiple sources, classifies each source and provides threat information to the countermeasures system for response. It can be interfaced to a chaff/flare dispenser or integrated as part of a DIRCM SPS. According to Northrop Grumman, the system's simplicity allows for internal installations or external mounting in a pod or pylon. The AAR-54(V) is an integral part of the AN/AAQ-24V/ARI 18246 DIRCM and has passed flight testing on a Sea King helicopter and a C-130. A six-sensor system integration is possible on the F-16 in a PIDS+ and pylon installation.

ORBITAL ATK DEFENSE ELECTRONIC SYSTEMS

AN/AAR-47A(V)2

The AN/AAR-47A(V)2 Missile and Laser Warning System (MWS) is an EW aircraft survivability system designed to protect low and slow flying fixed- and rotary-wing aircraft against surface-to-surface/air missiles and laser-guided or aided threats. Upon detection of the threat,

the MWS will automatically initiate countermeasures and provide an audio and visual warning to the pilot. The AAR-47 system consists of a computer processor, control indicator (CI) and four optical sensor converters. The MWS is designed to interface with an onboard radar warning set, a countermeasures dispensing set and either the CI provided or a multi-function, multi-purpose display. The sensor upgrade programme to the AAR-47 was designed to improve missile warning performance and incorporated laser warning functionality. The new missile warning sensor incorporates an additional internal detector into the widely fielded AAR-47(V)2 sensor. The upgrade was a USN-led joint programme with active USAF and USSOCOM participation. Power: 28V DC Weight: 13.6kg (combined)

AN/AAR-47B(V)2

The AN/AAR-47B Missile Warning System (MWS) is an EW system designed to protect low/slow-flying aircraft against surface-to-air and air-to-air missiles. The MWS will detect a missile fired at the aircraft or a laser pointed at the aircraft. Upon detection of the threat the MWS will automatically initiate countermeasures by sending a command signal to the ALE-39, ALE-40 or ALE-47 Countermeasures Dispensing Set. The system supports US DoD and allied helicopters and transport/cargo type aircraft in various operational environments. Variants of the AAR-47 have been fielded on over 3,000 aircraft including the AH/UH-1, CH-46, CH/MH-47, CH-53, HH/MH/SH/UH-60, S-61, S-92, and Bell 214, 407 and 412 rotorcraft; as well as the P-3, C-5, DHC-7, DHC-8, MC/UC-12, C-17, MV-22, RC-26, C-27, BT-67, C/KC-130, AC-208 and Beech 1900 fixed-wing aircraft.

ShotFinder Acoustic

The ShotFinder Acoustic is Orbital ATK's acoustic hostile fire detection system. The system uses acoustic technology to enable the detection of small-to-large calibre shots (5.45-40mm) from ranges of 50m-3km. It can also detect tracer rounds from muzzle blasts from anti-aircraft artillery, unguided rockets and rocket-propelled grenades. The system is lightweight and designed to be easily installed with multiple display options. ShotFinder uses a single 305mm diameter, 12.7mm high 'pancake' sensor mounted flush against the aircraft. The acoustic sensor can be used as a stand-alone Hostile Fire detection system or in conjunction with other Threat Warning Systems, such as the company's AAR-47, to provide a complete threat awareness capability. According to Orbital, the system has a nearly zero false indication rate with approximately 95% probability of indication. When combined with an EO missile warning system, ShotFinder can refine the determination of threat angle, range and shooter geolocation. Applications: acoustic hostile fire detection Length: 33cm Height: 2.54cm Power: 4W Weight: 3.6kg Operating platforms: fixed-wing aircraft and helicopters

SAAB

MAW 300

The MAW 300 is a UV MAW system developed from the earlier MAW 200. The new system features improved software, a wider instantaneous FOV and more compact packaging. It is also lighter and offers more flexibility for installation and integration. The MAW 300 forms part of the Compact Integrated Defensive Aids Suite (CIDAS) 100 which can process imports from up to six MAW 300 sensor heads. It also forms part of a more complex CIDAS 300 suite which includes radar warning capabilities. The MAW 300 balances high probability of warning, low false alarm rates and fast response times through the use of advanced neural network-based algorithms. A probability of warning has been made possible by the neutral network's superior pattern recognition capability. It features a seamless tracking and handover between sensors and is capable of tracking more than eight targets simultaneously. Applications: Missile advanced warning FOV - Conical: 110°

THALES

MWS-20

The MWS-20 is an active MAW based on a Doppler radar which detects and continuously tracks any type of approaching missile during all of its flight phases. The MWS-20 provides the pilot with estimate information regarding missile time-to-impact, missile range and speed and direction-of-arrival (DOA). The system's ability to process the missile time-to-impact data enables the system manager to select and trigger the appropriate counter-measures sequence at the optimum time for optimised self-protection. MWS-20 does not require a missile characteristic library. This makes the system easier to operate. Specific threat coherence processing techniques increase the system's immunity to intentional or unintentional counter-measures which also reduces the risk of false alarms. The MWS-20 has be designed to counter the threat of MANPADS or SAMs and acts as a 'switch on and forget' device enabling the system to run without crew actions. The MWS-20 is currently in service on the Cougar, EC725 and Puma helicopters, C-130 and HOS aircraft. Applications: Missile approach warner Weight: <20kg Operating platforms: Cougar, EC725 and Puma helicopters, C-130 and HOS aircraft MTBF: 500H FOV - Conical: 360°

RADAR WARNING RECEIVERS

BAE SYSTEMS

ALR2002

The ALR-2002, first developed in 1992, is an RWR designed and built in Australia by BAE Systems. It provides military aircraft with the ability to detect and avoid modern radar guided weapons. The system comprises four quadrant receivers, a low-band receiver, data processor, track and interface processor and a colour threat display. The receiver was designed to meet the Royal Australian Air Force (RAAF) operational requirement for a replacement RWR for the F-111 aircraft. The system was also designed to be installed on the RAAF's Black Hawk and Chinook helicopters under phase 2A of Project Echidna. The ALR-2002B variant continues to be developed for use with transport and rotary wing aircraft. Weight: <40kg Emitter modes: CW, low and high PRF, pulse-Doppler and complex Operating platforms: 2002B (F/A-18) and 2002D (S-70) Frequency coverage: standard frequency range coverage, expansion capability to millimetre wave and EW suite controller

AN/APR-44(V)

The AN/APR-44(V), developed by BAE systems, is a small, lightweight RWR with low power consumption. The system was designed for helicopter and fixed-wing applications aimed at CW emitters. Available in three versions: H/I radar band, APR-44(V)1, J-band APR-44(V)2 and H/I/J-band APR-(V)3. It was in service with the US army and Marine Corps. Its known platforms include EH-1, EH-60, OH-58, OV-1D, RC-12, RU-21, RV-1D and UH-1N. Operating platforms: US Army helicopters and special mission fixed-wing aircraft

DTS

DM/A-104

The DM/A-104 is a small, light modular wideband RWR for rotary- and fixed-wing aircraft. The system includes four orthogonal antennas for 360° coverage in the 2-18GHz frequency range, with each containing wideband crystal video receiving channels. The digital signal processor ensures simultaneous real-time evaluation of multiple emitters. This enables the pilot to be presented with the type, lethality level and detection of arrival, plus audio warning. Threats are classified according to a user-programmable database. The system can identify surveillance radar, acquisition radar or a fire control radar in lock on mode or whether the transmission is from a continuous wave radar. Azimuth coverage: 360° Frequency coverage: covers 2-18GHz (0.5-2GHz optional) Sensitivity: -50dBm (pulse); -50dBm (C/D-band) Bearing accuracy: >10° RMS

ELETTRONICA

ELT/156X Family

The ELT/156X is a family of light RWRs designed to provide self-protection for utility and combat aircraft and helicopters. It is designed to detect, analyse and identify all EM emissions that pose a threat to the platform. For a full EW suite, the controller monitors the multi-threat scenario and coordinates the countermeasures. The coverage of the system can be extended into the millimetre-wave range. The systems have been installed on the following platforms: AW129, AB212, CH-47, AB412, SH-3D, AB205, AMX. Frequency coverage: E-J bands (extendable to K band)

ELT/160 Family

The ELT/160 family of light RWRs are designed to provide utility and combat aircraft or helicopters with self-protection capabilities in operational scenarios. This includes scenarios characterised by high-density EM environments. All ELT/160 RWRs can be provided with an EW controller function that coordinates multiple sensors and actuators, operating within a tactical network to contribute to a common operational picture in net-centric operations. System features include high interception probability, full azimuth coverage, wideband RF coverage (E-K), automatic warning of high-priority emitters, light weight, flight line reprogrammable and field maintainability. The ELT/160 family is capable of operating with raw data libraries (mission data), and automatically analyses, classifies, displays and records unknown emissions (ie not pre-loaded in the library) and is capable of operating as an EW controller that exploits/performs functions for multi-sensor coordination. All versions of the system can be interfaced with MFDs and some models are provided with their own synthetic display. Azimuth coverage: 360°

IAI ELTA SYSTEMS

ELL-8265 - RWL

The ELL-8265 RWL is IAI Elta's radar warning and locating system for fixed-wing aircraft, helicopters and UAV platforms. The system provides the ability for aircrew to view a situational awareness map in real time and the locator provides operational alternatives such as bypassing or attacking the threat. The threat location can also be shared with other mission participants. Upon threat detection the system provides immediate indication of the threat type, geo-location and relative kill zone on the moving map in the cockpit or in the GCS for UAV applications. The ELL-8265 can be installed and integrated on a variety of manned or unmanned aircraft. It uses standard spiral antennas with no pre-mission calibration required. The system operates autonomously with minimal pilot intervention. Features include autonomous threat warning and locating capability by a single aircraft and 'on the fly' during the original mission, as well as a wide instantaneous detection frequency band, 360° spatial coverage, sensitivity, selectivity, reliability, low lifecycle cost, dual-channel digital receiver and lightweight and compact system, claims the company. Length: 30cm Width: 22cm Height: 18cm Power: 170W Weight: 11.5kg Azimuth coverage: 360°

LEONARDO AIRBORNE & SPACE SYSTEMS

SEER

SEER is a digital RWR. The system is sensitive, providing detailed parametric and angle of arrival measurement of intercepted signals. SEER is programmable, allowing users to configure its operation with indigenous mission-dependent data. It is offered in E-J band configuration with the ability to upgrade to C/D-K band capability. Its small footprint, low weight and power characteristics make it suitable for a range of new or upgrade programmes, including fixed- and rotary-wing aircraft and UAS. Operating platforms: Hawk Mk 209

Sky Guardian 2000

Sky Guardian 2000 is an RWR that provides situational awareness and threat warning and includes a central hub for integrating other EW sensors and countermeasures. The equipment is suited to low fliers such as helicopters and transport aircraft where engagement ranges can be short and rapid reaction is required. Sky Guardian 2000 integrates directly with aircraft systems via its 1553B databus for controls and displays via a glass cockpit. Alternatively, the system can be provided with its own control and display capability for installation into the platform. The RWR measures intercepted radar parameters and uses software and digital hardware signal processing to characterise the environment and inform the operator. It identifies emitters and systems by matching measured data to a pre-loaded, user-controlled library initiating warnings and countermeasures if necessary. It is installed on UK Apache, Sea King, Merlin and export helicopters. Power: 28V 8A, 350VA 3ph 115V 400Hz Weight: 23kg

Sky Guardian 2500

The Sky Guardian 2500 is a compact ESM suited to smaller platforms. Following extensive verification and trials, the Sky Guardian 2500 has been accepted into service on a number of aircraft in different configurations. The system measures intercepted radar in bands C-K. It is integrated with the onboard radar in a single combined HCI. The Sky Guardian 2500 identifies emitters and systems by matching measured data to a pre-loaded, user-controlled library. Recording of the intercepts can also be used for post-mission analysis and central database update. The programmable Defensive Aids Suite controller can control and co-ordinate EW sensors and countermeasure systems such as missile and laser warning systems, countermeasure dispensers and active jammers, to form an integrated platform protection system. Applications: ESM Operating platforms: Super Lynx 300 Frequency coverage: Bands C-K

LEONARDO UK

SG200-D

SG200-D is a UK-specific product from the family of Leonardo's SEER systems. An advanced digital RWR, SG200-D is self-protection equipment which detects and identifies emitters in high density and complex radar environments. In July 2015, the UK MoD awarded Leonardo a €27 million ($28.5 million) contract to supply its SG200-D radar warning receivers for the Puma Fleet. The contract includes a number of full sets of SG200-D equipment and additional sets for spares and training. Also included are sever sets of A-kit equipment – the antennas and cockpit control equipment needed to quickly install the full system as helicopter switches over from a training to operational environment. Applications: RWR Operating platforms: RAF Puma and CH-47 Chinook

LOCKHEED MARTIN

AN/ALQ-210 ESM Situational Awareness and Threat Warning

The multi-mission AN/ALQ-210 ESM system provides situational awareness and threat warning with Electronics Intelligence (ELINT) quality measurement accuracy in complex and dense electronic battlefield scenarios. The system performs situational awareness and threat warning functions simultaneously. The system also autonomously scans the environment allowing for a high probability of detection and accurate identification. The system operation is completely tailorable through Mission Data Loads which can be reloaded in flight for adapting to each geographic region. The AN/ALQ-210 system was designed to provide network-centric construct necessary to support the following functions and missions: intelligence surveillance and reconnaissance, threat warning, anti-submarine warfare, suppression of enemy air defence, strike targeting missions, situational awareness, armed surveillance and anti-ship warfare. Further features of the radar system include rapid response time, automatic cueing of countermeasures, self-calibrating for optimal signal collection, built-in diagnostic test capability, an open architecture and a programme emitter library. Length: 31.5cm (antenna WRA); 20cm (R/P WRA) Width: 38.4cm (antenna WRA); 25.7cm (R/P WRA) Height: 24.3cm (antenna WRA); 39cm (R/P WRA) Power: 400w Weight: 7kg (antenna WRA); 25.7kg (R/P WRA) Azimuth coverage: 360°

AN/APR-48A

The APR-48A is an RF interferometer, featuring a four-element interferometer combined with a three-channel phase receiver. A four-element coarse DF array is used for initial signal acquisition. When fine direction-finding (DF) measurement is required, a four-element, long-baseline interferometer is used. This provides high DF accuracy and a tolerance of multi-path-induced phase errors. The system includes second generation wideband antenna, receiver and processor design with integrated RF components using GaAs and MMIC interferometer for precise AOA. VLSI chip technology for monopulse parameter measurement and digitisation. A COTS single-board computed with an OFP and emitter library for processing is also included. A digital MIL-STD-1750A processor sorts the incoming pulses, computes DF, characterises and identifies emitters and determines threat priority. A User Data Module allows the system to be adapted to new threats in less than five minutes using HOL for easy software maintenance. The system is capable of accurate angle-of-arrival measurements and can be configured into a single line replaceable unit, while expansion modules permit growth to millimetre wave for expanded threat capability. Applications: detects, identifies and locates radar emitters precisely in varying terrain and heavy EM interference Weight: 13.3kg Operating platforms: AH-64D Apache Longbow

NORTHROP GRUMMAN

APR-39(V)

The ARP-39(V) is a RWR system for combat helicopters, low-speed aircraft and fast attack craft. The system comprises two dual-video receivers, four spiral cavity-backed antennas, NOE blade antenna, indicator unit, a comparator and control unit. Current configurations of the system are the APR-39(V)2, APR-39(V)2 and the APR-39(D)V2 is currently in development. All variants cover the frequency range from band C to K and provide conventional radar warning. The APR-39A(V)2's sensitive multi-receiver architecture provides rapid identification and continuous 360° threat warning. The APR-39B(V)2 also functions as an EW management

The SEER digital radar warning receiver is programmable, allowing users to configure its operation with indigenous mission-dependent data. (Photo: Leonardo Airborne & Space Systems)

system, serving as the heart of Northrop Grumman's suite of Integrated Sensors and Countermeasures, which integrates and displays data from onboard sensors (RF/IF/EO). The APR-39D(V)2 RWR and electronic warfare management system is currently being designed to provide improved aircrew situational awareness through interactive management of all onboard sensors and counter measures. The new configuration will merge the C(V)2 baseline with Northrop Grumman digital receiver product line. The system will feature the latest technology in a small, lightweight configuration that protects a wide variety of fixed-, rotary- and tilt-wing aircraft. In November 2013, Northrop Grumman announced that it had performed a series of tests using one of the company's Bat UAVs, equipped with the APR-39. More than 7,000 APR-39 systems have been installed on US and international AH-1W/Z, UH-1N/Y, MV-22B, KC-130T, UH-60, OH-58D, CH-53, CH-46, AH-64A/D and CH-47 aircraft. Power: 222W, 28V DC Weight: 17.6kg Operating platforms: combat helicopters, low-speed aircraft and fast attack craft Frequency coverage: band C to K

LR-100

Northrop Grumman's LR-100 is an RWR, ESM and ELINT receiver system. The system's footprint and weight make it suitable for installation on a range of air, sea or land-based platforms, including lightweight UAVs. The LR-100 offers pulse parameter measurements for PRI, pulse width, frequency, amplitude and time of arrival phase. It also determines direction of arrival by using phase, amplitude, TDOA or frequency Doppler technique and outputs formatted data reports. The system provides a geolocation capability and the standard LR-100 configuration automatically searches 2-18GHz in frequency with dual adaptive bandwidth superheterodyne receivers. Utilising phase interferometry and passive ranging technology, the system provides situational awareness with geolocation of emitters for cueing other onboard sensors. The geolocation and target cueing capability was combat-proven in Operation Enduring Freedom. The LR-100 was used to cue other sensors to reduce the target search time required for each device. Interfaces of the RWR include RS-232, RS-422, MIL-STD-1553 and Ethernet. The system also features in-flight programmability for changing mission requirements, real-time EOB surveillance and ESM reporting and radar warning and display. In 2009, the LR-100 was in production for the Global Hawk UAV, Kaman SH-2G helicopter, the Sikorsky S-70B Seahawk helicopter and special operations aircraft, submarines and patrol boats. In addition, the system has been installed and validated on the P-3 Orion, Hunter UAV, ASCIET aerostat, Predator UAV and the USN C-28 aircraft. Power: 219W Weight: 27kg Amplitude: <15° DF accuracy: <1° Frequency coverage: 2-18GHz

TELEDYNE DEFENCE & SPACE

QR020 Phobos

The Phobos-R threat warner/radar ESM is a man-portable, end-to-end integrated EW sensor system comprising antennas, RF processing, digital processing, de-interleaving and emitter ID/library matching and operator interface. A key feature of Phobos-R is that there are no external cables, calibration or positioning alignment requirements during set up enabling ease of deployment. The system is capable of operating on a variety of small platform types. The sensor employs a high degree of RF and DSP integration, enabling the full 2-18GHz frequency and 360° azimuth coverage to be achieved in a small and lightweight unit, weighing less than 7kg. Only two external cables are required for sensor operation – DC power (9-36V at 24W) and a network cable for data output/system control. The system includes options for remote location of the sensor unit relative to the user interface, frequency extensions to 0.5 and 40GHz and for the Callisto 3D pulse analysis tool, which provides live pulse-level signals analysis. The sensor is designed to be robust in dene signal environments and the user interface requires minimal operator workload or training, running on a ruggedised laptop or handheld device. Phobos-R can also be used in conjunction with CESM/COMINT as a frequency extension for tactical sensor suites. The rapid threat warning response of under one second enables the use of the system in conjunction with self-protection measures such as automatically set-on responsive jammers (ECM/EA) and it in conjunction with CESM as a frequency extension for low cost combined EW sensor suites. Applications: tactical threat warning Length: 190mm Width: 150mm Height: 43mm Power: consumes 24W in operating mode Weight: 1.9kg Emitter modes: expandable library capacity of more than 5,000 emitter mode lines MIL Standards: MIL-STD-2525 symbology Frequency resolution: 25MHz frequency resolution (option for <8MHz) Pulse density measurements: 1 million pps Frequency coverage: 2-18GHz instantaneous Sensitivity: -57dBm Amplitude resolution: 0.2dB Pulse width measurements: down to 75ns

THALES

EWR-99

Programmable wideband RWR for helicopters/transport aircraft. Detects CW, pulse and pulse-Doppler radars in dense EM environments. Can control chaff/flare dispensers and work with MWS-20 missile warner. Includes four antennas, CDU and single-box receiver/processor. The Thales Detexis EWR-99 is a programmable wideband Radar Warning Receiver for helicopters and transport aircraft. The RWR detects CW, pulse and pulse-Doppler radars in dense EM environments. It is also capable of controlling chaff/flare dispensers and works with the MWS-20 missile warner. The system includes four antennas, CDU and single-box receiver/processor. The EWR-99 can be integrated into the AS550 helicopter. Operating platforms: helicopters/transport aircraft

TDS-H

The TDS-H, a threat detection system is a compact, user-programmable RWR. It's sensitive instantaneous frequency measurement capability enables high POI and early warning. The system utilises miniaturised technology and claims to offer high performance whilst maintaining its low weight, volume and power consumption features. The TDS-H is designed to provide threat warning for helicopters and tactical aircraft with a frequency range of E-K and optional growth to D band. The system is integrated into Thales' SPH-H, an integrated self-protection system for helicopters. Applications: detection and DF of all types of signals (CW, pulsed and pulse-Doppler emitters) in dense environments Weight: 6kg with aerials

RF JAMMERS

AIRBUS DEFENCE & SPACE (GERMANY)

SY 1500

Communications jamming system capable of airborne, land or maritime operation. Operating frequency: Covers 20-500MHz band in two parts – 20-100 and 100-500 Operating platforms: South African Air Force Oryx helicopters

ELBIT SYSTEMS EW & SIGINT – ELISRA

SPJ-20

The SPJ-20 is a self-protection radar jammer for fixed-wing aircraft and helicopters. Engages the following ECM techniques: range and velocity gate pull-off, AM, false targets and noise. Utilises CW repeater, pulse repeater, two RF sources as ECM resources. Weight: 42kg Operating frequency: 6-18GHz (with option of 2-18GHz by adding power amplifiers)

ELETTRONICA

ELT/568

The ELT/568 is a solid-state airborne self- and mutual-protection family of ECM systems, designed to provide a defensive and attack capability for the last generation of fighter aircraft and helicopters. Key elements are solid-state Rx/Tx modules and associated antennas that are arranged to produce multi-beam patterns for multi-threat engagement, with low power requirements and graceful degradation. Its modular architecture allows configuring the system to meet the specific spatial coverage or ERP requirements. The different versions of ELT/568 allow management from four simultaneous threats (where two can have high transmission duty) up to 16 threats, based on the relevant transmitter unit (TWT or solid state) and antenna configuration. Operating frequency: H-J and E-G bands

HARRIS ELECTRONIC SYSTEMS

AN/ALQ-136

The AN/ALQ-136 is an exportable, automatic, power-managed radar jammer system designed to provide protection for attack helicopters and special operations aircraft. Deployed on US and export AH-64 Apaches, versions of the ALQ-136 include the ALQ-136(V)2, which traces its lineage to the ALQ-136(V)1/5 combat-proven in Operation Desert Storm and the ALQ-136(V)7, which provides digital receiver/DRFM-based jamming capabilities to counter pulse, pulse-Doppler and CW threat systems. US Army aviation officials reported the 'outstanding performance' of the ALQ-136 as a primary contributor to mission success during combat operations, says the company. It has been installed on special operations and mission aircraft such as RC-12, MH-47E, MH-60K, EH-60A,

LEONARDO DRS

SI-8649A/PF PicoFlexor Transceiver

The PicoFlexor Transceiver is a miniature tactical software-definable radio (SDR) platform that integrates a transmitter with a high-performance SIGINT superheterodyne receiver in a single low SWaP package. The unit's SIGINT receiver supports a frequency coverage of 2MHz to 3GHz with an instantaneous 25MHz bandwidth. Its transmitter provides V/U/SHF coverage with 'excellent' wideband transmit performance in an instantaneous 56MHz bandwidth at centre-tuned frequencies of 70MHz to 6GHz and transmit performance at centre-tuned frequencies down to 48MHz, providing coverage down to 20MHz within its instantaneous bandwidth. The transmitter has sub-octave post-selection filtering for harmonic rejection and a selectable noise source to provide a host of capabilities for electronic warfare applications such as RF jamming, deception or disruption.

NORTHROP GRUMMAN

ALQ-162

The ALQ-162 is a self-protection jammer used by three US military services and allied nations. Installed internally on many helicopters, inside the ALQ-164 pod on AV-8B, and inside a wing pylon on F-16 and F/A-18. AN/ALQ-162, it is designed to counter the full range of existing CW and pulse-Doppler terminal radar threats and defeat multiple threats in the same band simultaneously. The ALQ-162 is the only RF jammer in current production that provides protection from both CW and pulse-Doppler threats for various helicopters, says Northrop Grumman. The ALQ-162 automatically scans the threat environment, identifies and prioritises emitters, and assigns and generates deceptive countermeasures, all under user-defined software control that is flightline-programmable. Packaged in a single 18kg box of less than 0.01m^3 volume, the ALQ-162 can be integrated with other EW equipment, such as RWRs, pulse radar jammers, MWSs and EW management systems. In recent years, DRFM technology has been added that enables the system to jam even the most advanced pulse-Doppler radars, says the company. Similarly, the addition of microwave power technology to the ALQ-162 has more than doubled the system's effective radiated power. Growth options for the ALQ-162 include a next-generation integrated pylon/EW SPS that accommodates a passive MAW and an integrated dispenser system, in addition to the ALQ-162. Additional system enhancements under development include increased threat-handling capability to defeat multiple threats in different bands simultaneously, as well as an additional pulse capability. Other potential areas include RF technique generation for fibre-optic towed decoys and complete integration of RF systems with DIRCM. Applications: counter CW and pulse-Doppler terminal radar threats Weight: 18.14kg Operating platforms: ALQ-164 pod on AV-8B, and inside a wing pylon on F-16 and F/A-18

TRJ

The Tactical Radar Jammer (TRJ) is a system for both support jamming and self-protection of UAVs, helicopters and light tactical aircraft. Part of T-RECS. Weight: 46.3kg Operating frequency: 0.5-18GHz standard, 0.1-40GHz option

PRODUCTS

GUIDE TO SUPPLIERS

This section lists key companies supplying goods, services and equipment to the military helicopter industry worldwide.

The section is separated into two listings, by product then by supplier.

Products are listed alphabetically with suppliers and their location under each.

Supplier listings from p168 are shown alphabetically and include:

- company address
- email and website addresses
- telephone and fax numbers
- contact names

Highlighted entries also include the company's logo and a summary of activity.

To update a listing or submit new information, email Karima Thibou at karima.t@shephardmedia.com

ABOVE: US marines refuel a UH-1Y Venom helicopter during a Weapons and Tactics Instructors Course at Chocolate Mountain Aerial Gunnery Range, California, in October 2017. (Photo: USMC)

PRODUCTS

Accessories

3M Aerospace (USA)
Aage Christensen (DENMARK)
ACES Systems (USA)
ADS (USA)
Aero Telemetry (USA)
Air Asia Company (TAIWAN)
Air Covers (UK)
Air Methods (USA)
Airborne Industries (USA)
Airbus Helicopters (FRANCE)
All-System Aerospace International (USA)
AmSafe Logistics & Support (UK)
Armour of America (USA)
ASE (ITALY)
ASU Baltija (LITHUANIA)
Aviall Australia (AUSTRALIA)
Barum & Dewar (UK)
Breeze-Eastern (USA)
Breitling (SWITZERLAND)
Bruggemann (GERMANY)
Capewell Aerial Systems (USA)
CFD International (USA)
Claverham (UK)
Cliffdale Manufacturing (USA)
Concorde Battery (USA)
Controp Precision Technologies (ISRAEL)
Dakota Air Parts International (USA)
DART Aerospace (CANADA)
David Clark Company (USA)
Dillon Aero (USA)
DMS Technologies (UK)
Downing Heliport Systems (USA)
Drallim Industries (UK)
EDMO Distributors (USA)
Electronic Concepts & Engineering (USA)
Emergency Beacon (USA)
Emteq (USA)
Euravia (UK)
Executive Instruments (USA)
FDC/aeroFilter (USA)
Flight Helmet (USA)
Flight Helmets Australia (AUSTRALIA)
GSI International (USA)
HAL – Hindustan Aeronautics (INDIA)
Hanz USA (USA)
Hawker Pacific (AUSTRALIA)
Hawker Pacific Aerospace (USA)
Hawker Pacific Middle East (UAE)
Heli-Mart (USA)
Helicopter Support (USA)
Helispec (USA)
Helylux Industries (FRANCE)
Honeywell Aerospace (USA)
HR Smith Group of Companies (UK)
Interactive Safety Products (USA)
L3 Avionics Systems (USA)
L3 Wescam (CANADA)
Linstol (USA)
LKD Aerospace (USA)
Luma Technologies (USA)
MAC Aerospace (USA)
Masley Enterprises (USA)
Measurement Systems International (USA)
Meeker Aviation (USA)
Meggitt Sensing Systems (SWITZERLAND)
Merit Apparel (USA)
MH-Technologies (FRANCE)
Motorflug Baden-Baden (GERMANY)
MSA Gallet (FRANCE)
Nordam Transparency Division (USA)
Onboard Systems International (USA)
Ordtech Military Industries (SWITZERLAND)
Oregon Aero (USA)
Paravion Technology (USA)
Parker Aerospace - Aircraft Wheels & Brakes (USA)
Parker Aerospace - Control Systems (USA)
PM Research (USA)
Polyformes (UK)
Powervamp (UK)
Pratt & Whitney Canada (CANADA)
RBI Hawker (UAE)
REB Technologies (USA)
RF System Lab (USA)
Rolin Industries (USA)
Rotorcraft Services Group (USA)
RUAG Aviation (SWITZERLAND)
Safran Helicopter Engines (FRANCE)
Sandia Aerospace (USA)
Sayre Enterprises (USA)
Sibat (ISRAEL)
ST Aerospace (SINGAPORE)
Stag Group (UK)
Switlik Parachute Company (USA)
Thomas Jacks (UK)
Triumph Gear Systems (USA)
United Design (ITALY)
US Night Vision (USA)
Vector Aerospace Helicopter Services - UK (UK)
Vector Aerospace Helicopter Services North America (CANADA)

Air Conditioning/ Temperature Control

Adams Aviation (UK)
Advanced Cooling Technologies (USA)
Air Comm Corporation (USA)
Air Methods (USA)
Ametek Aerospace & Defense (USA)
B/E Aerospace (USA)
DIMO (USA)
Hawker Pacific (AUSTRALIA)
Hawker Pacific Aerospace (USA)
Hawker Pacific Middle East (UAE)
Honeywell Aerospace (USA)
IAI North America (USA)
Limco Airepair (USA)
Pacific Oil Cooler Service (USA)
Pall Aeropower (USA)
Paravion Technology (USA)
Port-A-Cool (USA)
Powervamp (UK)
Ross Aviation (UK)
ST Aerospace (SINGAPORE)
United Rotorcraft (USA)

Aircraft Covers

Air Covers (UK)
Cambrai Aircraft Covers (UK)
Cocoon (USA)
Dynatech International (USA)
Lite Flite (DENMARK)
Shield Technologies (USA)

Airframes

Airbus Helicopters (FRANCE)
Airbus Helicopters Inc (USA)
Aurora Flight Sciences (USA)
Australian Helicopters (AUSTRALIA)
AVIC – Aviation Industry Corporation of China (CHINA)
Avicopter (CHINA)
AVX Aircraft (USA)
Bell Helicopter Textron (USA)
Boeing Defense, Space & Security (USA)
Changhe Aircraft Industries Corporation (CAIC) (CHINA)
Denel Aviation (SOUTH AFRICA)
Enstrom Helicopter (USA)
HAL – Hindustan Aeronautics (INDIA)
Harbin Aircraft Industry Group (CHINA)
IAI North America (USA)
Indonesian Aerospace (INDONESIA)
KAI – Korea Aerospace Industries (SOUTH KOREA)
KAI-EC Helicopter (SOUTH KOREA)
Kaman Aerospace (USA)
Kawasaki Heavy Industries – Aerospace (JAPAN)
Leonardo DRS (USA)
Leonardo Helicopters (ITALY)
Leonardo UK (UK)
MD Helicopters (USA)
NH Industries (FRANCE)
Piasecki Aircraft (USA)
PZL-Świdnik (POLAND)
RUAG Aviation (SWITZERLAND)
Russian Helicopters (RUSSIA)
Sikorsky, a Lockheed Martin Company (USA)
ST Aerospace (SINGAPORE)
TAI – Turkish Aerospace Industries (TURKEY)
Times Aerospace Korea (SOUTH KOREA)

Ambulance/ Medevac Equipment

Aage Christensen (DENMARK)
Adams Aviation (UK)
ADS (USA)
AEM (UK)
Aerolite (SWITZERLAND)
Airbus Helicopters (FRANCE)
Astronics DME (USA)
Bell Helicopter Textron (USA)
Brief Relief (USA)
Combat Medical Systems (USA)
Doctor Down (USA)
Downing Heliport Systems (USA)
Enviro Systems (USA)
Essex Industries (USA)
Impact Instrumentation (USA)
Life Support International (USA)
LifePort (USA)
Lifesaving Systems (USA)
Lite Flite (DENMARK)
Masimo (USA)
Medical Innovations Group (UK)
MJ Cases (UK)
REB Technologies (USA)
S.O.S. Group (UK)
Skedco (USA)
Sloane Helicopters (UK)
Spectrum Aeromed (USA)
Switlik Parachute Company (USA)
Zodiac Aerospace Services (FRANCE)
Zodiac Oxygen Systems US (Avox Systems Inc) (USA)
ZOLL Medical (USA)

Armour

3M Technical Ceramics (GERMANY)
Armor Australia (AUSTRALIA)
ArmorWorks (USA)
ArmorWorks Canada (CANADA)
Armour of America (USA)
ArmourWorks (UK)
ASU Baltija (LITHUANIA)
BCA Ballistic Protection (BRAZIL)
Bullet Proofing Technology (SOUTH AFRICA)

Ceradyne (USA)
CoorsTek (USA)
IAI Golan Industries (ISRAEL)
ISBI Armoring (COLOMBIA)
Morgan Advanced Materials Composites and Defence Systems (UK)
MTL Advanced (UK)
Norinco (CHINA)
Optimal Armour (UK)
Permali Gloucester (UK)
Plasan Sasa (ISRAEL)
PPG Aerospace (USA)
Protech Armor Systems (USA)
Protective Group (USA)
Rheinmetall Ballistic Protection (GERMANY)
TenCate Advanced Armor (USA)

Associations

ADS Group (UK)
AFCEA International (USA)
AHS International (USA)
American Helicopter Services and Aerial Firefighting Association (USA)
Army Aviation Association of America (USA)
Association of the United States Army (USA)
Canadian Association of Defence & Security Industries (CANADA)
Helicopter Association International (USA)
ISBI Armoring (COLOMBIA)
Military Officers Association of America (USA)
National Defense Industrial Association (USA)

Cables and Connectors

Adams Aviation (UK)
Aircraft & Commercial Enterprises (USA)
Amphenol (UK)
Avionics Technologies (USA)
Click Bond (USA)
Crestwood Technology Group (USA)
FilConn (USA)
Harco (USA)
Icore International (Zodiac Interconnect US) (USA)
Isodyne (USA)
ITT Enidine (USA)
JIT Military Sales (USA)
Kuerzi Avionics (SWITZERLAND)
Lancer Systems (USA)
Micro-Coax (USA)
Mil-Base Industries (USA)
QRP (USA)
Senior Aerospace Metal Bellows (USA)
Spectrum Technologies (UK)
Staco Systems (USA)
W.L. Gore & Associates (USA)
W.L. Gore & Associates Cables (UK)
Yulista Aviation (USA)
Zodiac Aerospace Services (FRANCE)

Communication Systems

Active Headsets (USA)
Adams Aviation (UK)
Advanced Helicopter Services (USA)
Aerlyper (SPAIN)
Aero Telemetry (USA)
Aerodata (GERMANY)
Aeronautics (ISRAEL)
Air Methods (USA)
Airbus Defence & Space (FRANCE)
Airbus Defence & Space (GERMANY)
Airbus Defense & Space (USA)
Alion Science and Technology (USA)
Aselsan (TURKEY)
Astron Wireless Technologies (USA)
ASU Baltija (LITHUANIA)
Aviall Australia (AUSTRALIA)
Aviatech (USA)
Avibras Indústria Aeroespacial (BRAZIL)
Avionetics (SWEDEN)
Avionics Technologies (USA)
Axnes Aviation (NORWAY)
BAE Systems (UK)
BAE Systems Electronic Systems (USA)
BAE Systems Inc (USA)
Ball Aerospace (USA)
Becker Avionics GmbH (GERMANY)
Becker Avionics USA (USA)
Bharat Electronics (INDIA)
Blue Sky Network (USA)
Boeing Defense, Space & Security (USA)
Bose (USA)
Broadcast Microwave Services (USA)
Cobham Aerospace Communications (USA)
Cobham Antenna Systems Microwave Antennas (UK)
Controp Precision Technologies (ISRAEL)
Cooper Antennas (UK)
Cubic Global Defense (USA)
Curtiss-Wright Defense Solutions (USA)
Curtiss-Wright Defense Solutions UK (UK)
Dallas Avionics (USA)
David Clark Company (USA)
Dayton-Granger (USA)
Diehl Aerosystems (GERMANY)
Domo Tactical Communications (USA)
Dynetics (USA)
EDMO Distributors (USA)
Elbit Systems (ISRAEL)
Elbit Systems EW & SIGINT – Elisra (ISRAEL)
Emteq (USA)
ENSCO Avionics (USA)
Enterprise Control Systems (UK)
Esterline CMC Electronics (CANADA)
Esterline Palomar Products (USA)
Extant Aerospace (USA)
Flightcell International (NEW ZEALAND)
General Dynamics (USA)
General Dynamics Mission Systems (USA)
General Dynamics UK (UK)
Guardian Mobility (CANADA)
Harris (USA)
Harris Communication Systems (USA)
Hawker Pacific (AUSTRALIA)
Hayward & Green Aviation (UK)
Headset Services (UK)
HeliMedia (UK)
Hensoldt Sensors (GERMANY)
HISS (CANADA)
HR Smith Group of Companies (UK)
Hyundai J. Comm (SOUTH KOREA)
IAI ELTA Systems (ISRAEL)
IAI MLM Division (ISRAEL)
IAI North America (USA)
IMT – Integrated Microwave Technologies (USA)
Indra Sistemas (SPAIN)
Inmarsat (UK)
Inter-Coastal Electronics (USA)
Iridium Communications (USA)
Jabil (USA)
Jagid Management (USA)
Kongsberg Defence & Aerospace (NORWAY)
KVH Industries (USA)
L3 Aviation Recorders (USA)
L3 Communication Systems-West (USA)
L3 Mission Integration (USA)
L3 Telemetry & RF Products (L3 TRF) (USA)
L3 Wescam (CANADA)
Latitude Technologies (CANADA)
Leidos (USA)
Leonardo Airborne & Space Systems (ITALY)
Leonardo DRS (USA)
Leonardo Helicopters (ITALY)
Lockheed Martin Rotary and Mission Systems (USA)
Lockheed Martin (UK)
MASS (UK)
Mercury Defense Systems (USA)
Mercury Systems (USA)
Merit Apparel (USA)
MJ Cases (UK)
Motorflug Baden-Baden (GERMANY)
MSA Gallet (FRANCE)
N Systems (USA)
Navtech Systems (UK)
Northrop Grumman (USA)
Optical Air Data Systems (USA)
Rafael Advanced Defense Systems (ISRAEL)
Raytheon (USA)
Robinson Aviation (USA)
Rockwell Collins (USA)
Rockwell Collins ARINCDirect (USA)
Rockwell Collins (FRANCE)
Rockwell Collins (UK)
Rohde & Schwarz (GERMANY)
Saab (SWEDEN)
Scandinavian Avionics (DENMARK)
SCI-Technology (USA)
Scotty Group Austria (AUSTRIA)
Scotty Tele-Transport Corporation (USA)
Secure Communications Systems (USA)
Sennheiser Electronic (USA)
Sensor Systems (USA)
Sierra Nevada Corporation (USA)
SkyNet Mobile Communications (AUSTRALIA)
Sloane Helicopters (UK)
Specmat Technologies (USA)
ST Aerospace (SINGAPORE)
Sunhillo (USA)
Technisonic Industries (CANADA)
Tecom Industries (USA)
Telegenix (USA)
Telephonics (USA)
Teletronics Technology (USA)
Textron Systems (USA)
Thales Defense & Security (USA)
Thales UK (UK)
Times Microwave Systems (USA)
Times Microwave Systems International (UK)
Ultra Electronics Communication & Integrated Systems (UK)
Ultra Wood & Douglas (UK)
Uniflight (USA)
Universal Avionics Systems (USA)
Vector Aerospace Helicopter Services North America (CANADA)

Vislink (US) (USA)
VT Miltope (USA)

Completions, Modifications, Upgrades

AAR Airlift Group (USA)
Advanced Helicopter Services (USA)
Aerlyper (SPAIN)
Aero Precision (USA)
Aerodata (GERMANY)
Aerolite (SWITZERLAND)
Aeromaoz (ISRAEL)
Aeronautics (ISRAEL)
Aerospace & Defence Products (AUSTRALIA)
Air Asia Company (TAIWAN)
Air Methods (USA)
Airbus Helicopters (FRANCE)
All-System Aerospace International (USA)
Alpine Aerotech (CANADA)
Astronautics Corporation of America (USA)
ASU Baltija (LITHUANIA)
Aviation Specialties Unlimited (USA)
BAE Systems (UK)
Bell Helicopter Textron (USA)
Boeing Defense, Space & Security (USA)
Bristow Helicopters (UK)
CFD International (USA)
Columbia Helicopters (USA)
Consolite Technology (UK)
Crane Aerospace & Electronics (USA)
DynCorp International (USA)
Elbit Systems (ISRAEL)
Elbit Systems EW & SIGINT - Elisra (ISRAEL)
Elbit Systems Intelligence and Electro-optics - Elop (ISRAEL)
Emteq (USA)
EuroAvionics Navigationssysteme (GERMANY)
FDC/aeroFilter (USA)
Global Turbine Component Technologies (USA)
Hawker Pacific (AUSTRALIA)
Hawker Pacific Aerospace (USA)
Heli-Mart (USA)
Heli-One (CANADA)
Heli-One Europe (NORWAY)
Heli-One USA (USA)
Helispec (USA)
Honeywell International (USA)
IAI Lahav (ISRAEL)
IAR Brasov (ROMANIA)
J.F. Taylor, Inc. (USA)
L3 Communications MAS Canada (CANADA)
L3 Mission Integration (USA)
Lom Praha (CZECH REPUBLIC)
Moog Components Group (USA)
Motorflug Baden-Baden (GERMANY)
Nexter Systems (FRANCE)
NSE (FRANCE)
Oceania Aviation (NEW ZEALAND)
Ordtech Military Industries (SWITZERLAND)
Oregon Aero (USA)
Oxley Inc (USA)
QinetiQ (UK)
REB Technologies (USA)
RUAG Aviation (SWITZERLAND)
Russian Helicopters (RUSSIA)
Saab (SWEDEN)
Servo Kinetics (USA)
Sikorsky Helitech (AUSTRALIA)
SkyNet Mobile Communications (AUSTRALIA)
Sloane Helicopters (UK)
Snap-on Tools International (USA)
Spectrum Aeromed (USA)
ST Aerospace (SINGAPORE)
Star Aviation Inc (USA)
TAI - Turkish Aerospace Industries (TURKEY)
Thales UK (UK)
Uniflight (USA)
United Rotorcraft (USA)
Vector Aerospace Helicopter Services - UK (UK)
WestWind Technologies (USA)
Yulista Aviation (USA)

Computer Equipment/ Hardware

Airbus Defence & Space (Germany) (GERMANY)
Aitech Defense Systems (USA)
Ampex Data Systems (USA)
AMREL Systems (USA)
Arc-Tronics (USA)
Avalex Technologies (USA)
Calculex (USA)
Curtiss-Wright Defense Solutions (USA)
Curtiss-Wright Defense Solutions UK (UK)
GE Intelligent Platforms (UK)
General Dynamics Mission Systems (USA)
General Dynamics Mission Systems (CANADA)
L3 Aviation Recorders (USA)
L3 Targa Systems (USA)
Leonardo DRS (USA)
MaxVision (USA)
RDDS Avionics (UK)
SCI-Technology (USA)
Secure Communications Systems (USA)
Sunhillo (USA)
Teletronics Technology (USA)
Trimble (USA)
Ultra Electronics Communication & Integrated Systems (UK)
VT Miltope (USA)
Z Microsystems (USA)

De-icing/ Anti-icing Equipment

Airbus Helicopters (FRANCE)
Aviall Australia (AUSTRALIA)
Cobham Aerospace Communications (USA)
Cox & Company (USA)
David Clark Company (USA)
Hawker Pacific (AUSTRALIA)
Honeywell Aerospace (USA)
Liebherr Aerospace & Transportation (GERMANY)
Midwest Industrial Supply (USA)
Rolin Industries (USA)
RUAG Aviation (SWITZERLAND)
SpaceAge Control (USA)
Transaero (USA)
UTC Aerospace Systems (USA)

ECM/ESM/EW Systems

Aerlyper (SPAIN)
Aero Telemetry (USA)
Airbus Defence & Space (GERMANY)
Airbus Defence & Space (UK)
Alkan (FRANCE)
Astron Wireless Technologies (USA)
ASU Baltija (LITHUANIA)
BAE Systems (UK)
Bharat Electronics (INDIA)
BIRD Aerosystems (ISRAEL)
Chemring Countermeasures (UK)
Cubic Global Defense (USA)
Daylight Solutions (USA)
DTM Global (UK)
DTS (CHILE)
Dynetics (USA)
Elbit Systems (ISRAEL)
Elbit Systems EW & SIGINT - Elisra (ISRAEL)
Elettronica (ITALY)
Emteq (USA)
Extant Aerospace (USA)
Harris (USA)
Harris Communication Systems (USA)
IAI ELTA Systems (ISRAEL)
IAI Lahav (ISRAEL)
IAI North America (USA)
IMI Systems (ISRAEL)
Indra Sistemas (SPAIN)
Kanfit (ISRAEL)
Kilgore Flares Company, LLC (USA)
L3 Communications Randtron Antenna Systems (USA)
Lacroix (FRANCE)
Leonardo DRS (USA)
Lockheed Martin (USA)
Lockheed Martin (UK)
MASS (UK)
Meeker Aviation (USA)
Meggitt Defense Systems (USA)
Mercury Systems (USA)
MS Instruments (UK)
Northrop Grumman (USA)
Northrop Grumman (UK)
Orbital ATK (USA)
Ordtech Military Industries (SWITZERLAND)
POC - Physical Optics (USA)
Rafael Advanced Defense Systems (ISRAEL)
Raytheon (USA)
Raytheon Space & Airborne Systems (USA)
Rheinmetall (GERMANY)
Rheinmetall Defence Electronics (GERMANY)
Rheinmetall Waffe Munition (GERMANY)
Rohde & Schwarz (GERMANY)
RUAG Aviation (SWITZERLAND)
Saab (SWEDEN)
Saab North America (USA)
Safran Electronics & Defense (FRANCE)
Sierra Nevada Corporation (USA)
STM Savunma Teknolojileri Muhendislik ve Ticaret (TURKEY)
TAI - Turkish Aerospace Industries (TURKEY)
Teledyne Defence & Space (UK)
Terma (DENMARK)
Textron Systems Electronic Systems (UK)
Thales UK (UK)
Times Microwave Systems (USA)
Times Microwave Systems International (UK)
TNO (NETHERLANDS)

Electric Power Systems

Acme Aerospace (USA)
AEM (UK)
Aero Precision (USA)
Aitech Defense Systems (USA)
Ametek Aerospace & Defense (USA)
ASE (ITALY)
Avionics Technologies (USA)
B/E Aerospace (USA)
Bental Motion Systems (ISRAEL)
Ceteor (BELGIUM)
Codarra Advanced Systems (AUSTRALIA)
Columbia Helicopters (USA)
Concord Components (USA)
Concorde Battery (USA)

Crane Aerospace & Electronics (USA)
Crestwood Technology Group (USA)
Curtiss-Wright Defense Solutions (USA)
Curtiss-Wright Defense Solutions UK (UK)
Dakota Air Parts International (USA)
DMS Technologies (UK)
DRS Pivotal Power (CANADA)
Dynatech International (USA)
Eaton Aerospace - Fuel & Motion Control Systems Division (USA)
Floats & Fuel Cells / FFC Services (USA)
GE Aviation (USA)
Greene Tweed (USA)
Hawker Pacific (AUSTRALIA)
HISS (CANADA)
Honeywell Aerospace (USA)
Honeywell International (USA)
Leonardo DRS (USA)
MarathonNorco Aerospace (USA)
Metalite Aviation Lighting (UK)
MJ Cases (UK)
Orbit Instrument (USA)
Ordtech Military Industries (SWITZERLAND)
Powervamp (UK)
Quallion (USA)
Ross Aviation (UK)
SAFT (FRANCE)
ST Aerospace (SINGAPORE)
TDK-Lambda Americas (USA)
Teletronics Technology (USA)
Ultra Electronics Precision Air & Land Systems (UK)
Unitron Power Systems (USA)
Vertical (COLOMBIA)
Yulista Aviation (USA)
Zodiac Aerospace Services (FRANCE)

Engineering

AAR Mobility Systems (USA)
Aero Precision (USA)
Aero Simulation (USA)
Airbus Helicopters (FRANCE)
Alion Science and Technology (USA)
Alion Science and Technology Rapid Engineering Solutions (USA)
Alpine Aerotech (CANADA)
Arc-Tronics (USA)
Avion Solutions (USA)
Bonham Technologies (USA)
Booz Allen Hamilton (USA)
Bristow Helicopters (UK)
Camber (USA)
Cantine Armament (USA)
Cobham Aviation Services, Helicopter Services (UK)
East/West Industries (USA)
ecms Aviation Systems (GERMANY)
Euravia (UK)
Florida Turbine Technologies (USA)
Fulcrum Concepts (USA)
Hawker Pacific (AUSTRALIA)
Howell Instruments (USA)
Jabil (USA)
LaBrOs Engineering (GERMANY)
Leidos (USA)
Nusantara Turbin & Propulsi (NTP) (INDONESIA)
Patria Helicopters AB (SWEDEN)
Pro Star Aviation (USA)
Protective Group (USA)
Radiance Technologies (USA)
RAVCO (USA)
RedViking (USA)
Resource Group UAS (UK)
Robinson Aviation (USA)
Rotorcraft Services Group (USA)
RUAG Aviation (SWITZERLAND)
Russian Helicopters (RUSSIA)
S.A.B.C.A. (BELGIUM)
S3 (USA)
Science and Engineering Services (USA)
Seyer Industries (USA)
Sikorsky, a Lockheed Martin Company (USA)
Sunhillo (USA)
Thomas Instrument (USA)
URS Training & Simulation Engineering Team (TSET) (USA)
Vector Aerospace Helicopter Services North America (CANADA)

Engines

Aage Christensen (DENMARK)
Aerlyper (SPAIN)
Aero Precision (USA)
Aero Propulsion Support Group (USA)
Air & Ground (UK)
Air Asia Company (TAIWAN)
Air Technology Engines (USA)
All-System Aerospace International (USA)
Alturair (USA)
Asia Pacific Aerospace (AUSTRALIA)
Asia Pacific Aerospace (Singapore) (SINGAPORE)
ATEC – Advanced Turbine Engine Company (USA)
Aurora Flight Sciences (USA)
Aviall Australia (AUSTRALIA)
Avio (ITALY)
Bental Motion Systems (ISRAEL)
Bet Shemesh Engines (ISRAEL)
Bristow Helicopters (UK)
Columbia Helicopters (USA)
Dakota Air Parts International (USA)
Dynatech International (USA)
Euravia (UK)
GE Aviation (USA)
Global Turbine Component Technologies (USA)
HAL – Hindustan Aeronautics (INDIA)
Helicopter Engines MRO (HE-MRO) (INDIA)
Honeywell International (USA)
ITP Group (SPAIN)
LKD Aerospace (USA)
Lycoming Engines (USA)
M International (USA)
Magellan Aerospace (CANADA)
Mitsubishi Heavy Industries Aero Engines Ltd (MHIAEL) (JAPAN)
Motor Sich (RUSSIA)
Motorflug Baden-Baden (GERMANY)
MTU Aero Engines (GERMANY)
Nusantara Turbin & Propulsi (NTP) (INDONESIA)
Pratt & Whitney (USA)
Pratt & Whitney Canada (CANADA)
Pratt & Whitney Rzeszów (POLAND)
Rolls-Royce (UK)
Rolls-Royce Deutschland (GERMANY)
Rolls-Royce North America (USA)
Safran Helicopter Engines (FRANCE)
ST Aerospace (SINGAPORE)
StandardAero (USA)
Transupport (USA)
United Engine Corporation (RUSSIA)
United Engine Corporation (NPO Saturn) (RUSSIA)
UTC Aerospace Systems (USA)
Vector Aerospace Helicopter Services - UK (UK)

External Load

AAR Airlift Group (USA)
Air Rescue Systems (USA)
Airborne Systems North America (USA)
Ancra International (USA)
ASU Baltija (LITHUANIA)
Drallim Industries (UK)
DRS Training & Control Systems (USA)
ecms Aviation Systems (GERMANY)
Isolair Helicopter Systems (USA)
Mil-Base Industries (USA)
Simplex Aerospace (USA)

Flight Suits, Helmets, Headsets

Adams Aviation (UK)
Air Methods (USA)
ASU Baltija (LITHUANIA)
Aviall Australia (AUSTRALIA)
Bose (USA)
Dale Techniche (UK)
Dallas Avionics (USA)
Diehl Aerosystems (GERMANY)
DRIFIRE (USA)
EDMO Distributors (USA)
Elbit Systems (ISRAEL)
Flight Helmet (USA)
Flight Helmets Australia (AUSTRALIA)
Flightline Aviation Wear (USA)
Gentex (USA)
Hawker Pacific (AUSTRALIA)
Headset Services (UK)
Helmet Integrated Systems (UK)
Honeywell International (USA)
Interactive Safety Products (USA)
Life Support International (USA)
Linstol (USA)
Masley Enterprises (USA)
McDermott Aviation (AUSTRALIA)
Merit Apparel (USA)
MSA Gallet (FRANCE)
Mustang Survival (CANADA)
Northrop Grumman UK (UK)
RAVCO (USA)
Sayre Enterprises (USA)
Sennheiser Electronic (USA)
Switlik Parachute Company (USA)
Team Wendy (USA)
Transaero (USA)
Umevoice (USA)
United Design (ITALY)
Viking Life-Saving Equipment (DENMARK)
W.L. Gore & Associates (USA)
W.L. Gore & Associates Fabrics (UK)
Wilco International (FRANCE)

Fuel Systems

Adams Aviation (UK)
Aero Precision (USA)
Aero Sekur (UK)
Aerowing (USA)
Air & Ground (UK)
Airbus Helicopters (FRANCE)
Autoflug (GERMANY)

Aviall Australia (AUSTRALIA)
Columbia Helicopters (USA)
Crane Aerospace & Electronics (USA)
Dakota Air Parts International (USA)
Donaldson Aerospace & Defense (USA)
DynCorp International (USA)
Eaton Aerospace (USA)
Eaton Aerospace – Fuel & Motion Control Systems Division (UK)
Floats & Fuel Cells / FFC Services (USA)
GE Aviation (USA)
Hawker Pacific (AUSTRALIA)
Honeywell International (USA)
Hydromechanical Engineering (ISRAEL)
IAI North America (USA)
Lee Products (UK)
Liquid Measurement Systems (USA)
LKD Aerospace (USA)
M International (USA)
MJ Cases (UK)
Pacific Oil Cooler Service (USA)
Pall Aeropower (USA)
Parker Aerospace - Fluid Systems (USA)
Parker Aerospace - Fluid Systems Division (USA)
Parker Hannifin - Velcon Filtration Division (USA)
Powervamp (UK)
Precision Fuel Components (USA)
Pronal (FRANCE)
Robertson Fuel Systems (USA)
Ross Aviation (UK)
RSL Electronics (ISRAEL)
RSL Electronics USA (USA)
Sandia Aerospace (USA)
ST Aerospace (SINGAPORE)
Textron Systems (USA)
Transupport (USA)
UTC Aerospace Systems - Actuation Systems France (FRANCE)

Ground Support Equipment

AAR Mobility Systems (USA)
Adams Aviation (UK)
Advanced Torque Products (USA)
Aerowing (USA)
AGE Logistics Corporation (USA)
Air & Ground (UK)
Air Asia Company (TAIWAN)
Air Covers (UK)
Airbus Helicopters (FRANCE)
Alion Science and Technology Rapid Engineering Solutions (USA)
Alkan (FRANCE)
All-System Aerospace International (USA)
Alpine Aerotech (CANADA)
Ameripack (USA)
Armstrong Tools (USA)
Autoflug (GERMANY)
Aviall Australia (AUSTRALIA)
Bell Helicopter Textron (USA)
Bharat Electronics (INDIA)
Big Ass Fans (USA)
Censol (USA)
Ceteor (BELGIUM)
Cocoon (USA)
Columbus Jack (USA)
David Clark Company (USA)
DMS Technologies (UK)
DynCorp International (USA)
East/West Industries (USA)
EDMO Distributors (USA)
Fastening Systems International (USA)
Flexible Lifeline Systems (USA)
General Dynamics Mission Systems (CANADA)
General Dynamics UK (UK)
Gichner Shelter Systems (USA)
Gifas Electric (GERMANY)
Greene Tweed (USA)
Habco (USA)
HAL – Hindustan Aeronautics (INDIA)
Handling Systems (USA)
Hawk Enterprises (USA)
Hawker Pacific (AUSTRALIA)
Headset Services (UK)
Heatcon Composite Systems (USA)
Helitowcart (CANADA)
Honeywell International (USA)
HR Smith Group of Companies (UK)
Hydromechanical Engineering (ISRAEL)
Intercomp (USA)
JIT Military Sales (USA)
Kipper Tool (USA)
L3 Communications MAS Canada (CANADA)
Leonardo DRS (USA)
MarathonNorco Aerospace (USA)
MASS (UK)
Meggitt Sensing Systems (SWITZERLAND)
Metalite Aviation Lighting (UK)
Motorflug Baden-Baden (GERMANY)
Mototok International (GERMANY)
Naval Group (FRANCE)
Pall Aeropower (USA)
Paravion Technology (USA)
Port-A-Cool (USA)
Powervamp (UK)
RF System Lab (USA)
Rolin Industries (USA)
Ross Aviation (UK)
Rubb Military Buildings (UK)
Russian Helicopters (RUSSIA)
Southwest Solutions (USA)
Spokane Industries (USA)
Spydercrane (USA)
Systems Interface (UK)
Textron Systems (USA)
Unitron Power Systems (USA)
Walin Tools (USA)

Guided Missiles

Aselsan (TURKEY)
Autoflug (GERMANY)
Avibras Indústria Aeroespacial (BRAZIL)
Denel Dynamics (SOUTH AFRICA)
Diehl Defence (GERMANY)
General Dynamics (USA)
General Dynamics UK (UK)
IAI MBT Division (ISRAEL)
IAI North America (USA)
KBM (RUSSIA)
KBP Instrument Design Bureau (RUSSIA)
Kongsberg Defence & Aerospace (NORWAY)
L3 Telemetry & RF Products (L3 TRF) (USA)
LKD Aerospace (USA)
Lockheed Martin (USA)
Lockheed Martin Missiles and Fire Control (USA)
MBDA (FRANCE)
MBDA Italia (ITALY)
MBDA UK (UK)
Norinco (CHINA)
Northrop Grumman (USA)
Northrop Grumman (UK)
Ordtech Military Industries (SWITZERLAND)
Rafael Advanced Defense Systems (ISRAEL)
Raytheon (USA)
Raytheon Missile Systems (USA)
Roketsan (TURKEY)
Rosoboronexport (RUSSIA)
Tactical Missiles Corporation (RUSSIA)
TDA Armements (FRANCE)
Textron Systems (USA)
Thales (FRANCE)
Thales UK (UK)
ThalesRaytheonSystems (FRANCE)
V.A. Degtyarev Plant (RUSSIA)
Vympel (RUSSIA)

Guns

BAE Systems (UK)
CFD International (USA)
Denel Land Systems (SOUTH AFRICA)
Dillon Aero (USA)
Ekran Research Institute (RUSSIA)
FN Herstal (BELGIUM)
FNH USA (USA)
Garwood Industries (USA)
General Dynamics Ordnance and Tactical Systems (USA)
GriggTech (USA)
KBP Instrument Design Bureau (RUSSIA)
Nexter Systems (FRANCE)
Nobles Worldwide (USA)
Norinco (CHINA)
Orbital ATK (USA)
Ordtech Military Industries (SWITZERLAND)
Profense (USA)
Rheinmetall (GERMANY)
Rosoboronexport (RUSSIA)
US Ordnance (USA)
V.A. Degtyarev Plant (RUSSIA)

Heliports, Helidecks, Helipads

Bayards Aluminium Constructies (NETHERLANDS)
Downing Heliport Systems (USA)

Hook Systems

AD Aerospace (UK)
Air Asia Company (TAIWAN)
Airbus Helicopters (FRANCE)
Alkan (FRANCE)
AmSafe Bridport (UK)
Breeze-Eastern (USA)
Capewell Aerial Systems (USA)
Claverham (UK)
Dakota Air Parts International (USA)
Drallim Industries (UK)
ecms Aviation Systems (GERMANY)
Harmonic Drive (USA)
Hawker Pacific Middle East (UAE)
Lite Flite (DENMARK)
Measurement Systems International (USA)
Onboard Systems International (USA)
Polyformes (UK)
RBI Hawker (UAE)
SkyHook Rescue Systems (USA)
Transaero (USA)
Transupport (USA)

HUMS

Aero Precision (USA)
Air Methods (USA)
Airbus Helicopters (FRANCE)
Bristow Academy UK (UK)
Elbit Systems (ISRAEL)
GasTOPS (CANADA)
GE Aviation (USA)
Honeywell International (USA)
Howell Instruments (USA)

Humaware (UK)
L3 Aviation Recorders (USA)
Meggitt Sensing Systems (SWITZERLAND)
Moog Aircraft Group (USA)
Oxley Inc (USA)
RBI Hawker (UAE)
RSL Electronics (ISRAEL)
RSL Electronics USA (USA)
SpaceAge Control (USA)
Teledyne Controls (USA)
UTC Aerospace Systems (USA)

Hydraulic Systems

AEM (UK)
Aero Precision (USA)
Air Asia Company (TAIWAN)
Airbus Defence & Space (France) (FRANCE)
All-System Aerospace International (USA)
Ametek Aerospace & Defense (USA)
ASE (ITALY)
Aviall Australia (AUSTRALIA)
Claverham (UK)
Cliffdale Manufacturing (USA)
Columbia Helicopters (USA)
Concord XXI (CANADA)
DIMO (USA)
Eaton Aerospace – Fuel & Motion Control Systems Division (UK)
Fokker Services (NETHERLANDS)
GE Aviation (USA)
Greene Tweed (USA)
Hawker Pacific Aerospace (USA)
Hawker Pacific Middle East (UAE)
Helispec (USA)
Honeywell Aerospace (USA)
Honeywell International (USA)
Hydrep (FRANCE)
Hydromechanical Engineering (ISRAEL)
Isolair Helicopter Systems (USA)
Lee Products (UK)
Liebherr Aerospace & Transportation (GERMANY)
Moog Aircraft Group (USA)
Motorflug Baden-Baden (GERMANY)
Pall Aeropower (USA)
Parker Aerospace - Aircraft Wheels & Brakes (USA)
Parker Aerospace - Control Systems (USA)
RBI Hawker (UAE)
Servo Kinetics (USA)
ST Aerospace (SINGAPORE)
Textron Systems (USA)
Transaero (USA)
UTC Aerospace Systems - Actuation Systems (Microtecnia S.r.l.) (ITALY)
UTC Aerospace Systems - Actuation Systems France (FRANCE)
UTC Aerospace Systems - Landing Gear (USA)
UTC Aerospace Systems - Wheels and Brakes (USA)
Vector Aerospace Helicopter Services (UK)
Vector Aerospace Helicopter Services North America (CANADA)

Instruments, Displays

Adams Aviation (UK)
Aerlyper (SPAIN)
Aero Optical (UK)
Aero Precision (USA)
Aerodata (GERMANY)
Aeromaoz (ISRAEL)
Aeronautics (ISRAEL)
Aerosonic (USA)
Aerospace & Defence Products (AUSTRALIA)
Air & Ground (UK)
Air Asia Company (TAIWAN)
Air Methods (USA)
Airbus Defence & Space (GERMANY)
Airbus Defence & Space (UK)
Airbus Helicopters (FRANCE)
AMREL Systems (USA)
Anodyne Electronics Manufacturing Corp (CANADA)
Astronautics Corporation of America (USA)
Avalex Technologies (USA)
Aviall Australia (AUSTRALIA)
Avionetics (SWEDEN)
Avionics Technologies (USA)
BAE Systems (UK)
BAE Systems Electronic Systems (USA)
BAE Systems Inc (USA)
Becker Avionics (USA)
Britannia 2000 (UK)
CILAS (FRANCE)
Comtronic (GERMANY)
Consolite Technology (UK)
Control Products (USA)
Crestwood Technology Group (USA)
Curtiss-Wright Defense Solutions (USA)
Curtiss-Wright Defense Solutions UK (UK)
Dakota Air Parts International (USA)
Diehl Aerosystems (GERMANY)
DIMO (USA)
Eaton Aerospace – Fuel & Motion Control Systems Division (UK)
Elbit Systems EW & SIGINT – Elisra (ISRAEL)
Elbit Systems Intelligence and Electro-optics – Elop (ISRAEL)
Elbit Systems of America (USA)
Emteq (USA)
Esterline CMC Electronics (CANADA)
Esterline Control & Communication Systems (USA)
Executive Instruments (USA)
Forth Dimension Displays (UK)
Gamma Scientific (USA)
GE Aviation (USA)
GE Intelligent Platforms (UK)
HeliMedia (UK)
Honeywell Aerospace (USA)
Honeywell UK (Skyforce) (UK)
Howell Instruments (USA)
Interface Displays & Controls (USA)
L3 Avionics Systems (USA)
L3 Electrodynamics (USA)
Leonardo Airborne & Space Systems (ITALY)
Leonardo Helicopters (ITALY)
LKD Aerospace (USA)
Lockheed Martin Missiles and Fire Control (USA)
Luma Technologies (USA)
Max-Viz (USA)
Measurement Systems International (USA)
Meggitt Avionics (UK)
MH-Technologies (FRANCE)
Moog Components Group (USA)
Motorflug Baden-Baden (GERMANY)
Northrop Grumman Navigation Systems (USA)
Oppenheimer Precision Products (USA)
Orbit Instrument (USA)
Ordtech Military Industries (SWITZERLAND)
Paramount Panels (UK)
Paravion Technology (USA)
Parker Aerospace - Control Systems (USA)
Parker Aerospace - Fluid Systems Division (USA)
Patria Helicopters AB (SWEDEN)
Photo-Sonics International (UK)
POC - Physical Optics (USA)
RBI Hawker (UAE)
RDDS Avionics (UK)
REB Technologies (USA)
RGB Spectrum (USA)
Rockwell Collins (USA)
Rockwell Collins (FRANCE)
Rockwell Collins UK (UK)
Ross Aviation (UK)
RSL Electronics (ISRAEL)
RUAG Aviation (SWITZERLAND)
Saab North America (USA)
Safe Flight Instrument Corp (USA)
Sandel Avionics (USA)
Sandia Aerospace (USA)
Scandinavian Avionics (DENMARK)
SpaceAge Control (USA)
ST Aerospace (SINGAPORE)
Stop-choc (UK)
TDL-Tulip Development Laboratory (USA)
Teledyne Controls (USA)
Telephonics (USA)
Teletronics Technology (USA)
Thales (FRANCE)
Thales UK (UK)
Thommen Aircraft Equipment (SWITZERLAND)
Thommen America (USA)
Ultra Electronics Precision Air & Land Systems (UK)
Uniflight (USA)
Universal Avionics Systems (USA)
US Micro Products (USA)
UTC Aerospace Systems (USA)
Vector Aerospace Helicopter Services - UK (UK)
Vertical (COLOMBIA)
Wamco (USA)
Xenics (BELGIUM)
Z Microsystems (USA)

Integration, Integrated Systems

Advanced Helicopter Services (USA)
Aero Precision (USA)
Aero Simulation (USA)
Airbus Defence & Space (Germany) (GERMANY)
Airbus Defence & Space (UK)
Bonham Technologies (USA)
Booz Allen Hamilton (USA)
Camber (USA)
CFD International (USA)
Curtiss-Wright Defense Solutions (USA)
Curtiss-Wright Defense Solutions UK (UK)
ENSCO Avionics (USA)
Hawker Pacific (AUSTRALIA)
HISS (CANADA)
IAI MLM Division (ISRAEL)
ID Integration (USA)
Intuitive Research and Technology (USA)
L3 Targa Systems (USA)
Lockheed Martin Rotary and Mission Systems (USA)
Lockheed Martin UK (UK)
Meggitt Defense Systems (USA)
Phoenix Aerospace (UK)
Protective Group (USA)
Rockwell Collins ARINCDirect (USA)
Systron Donner Inertial (USA)
TAI – Turkish Aerospace Industries (TURKEY)

Terma (DENMARK)
Ultra Electronics Communication & Integrated Systems (UK)
Uniflight (USA)
Wyle (USA)
Yulista Aviation (USA)

Lights

Adams Aviation (UK)
Advanced Helicopter Services (USA)
Aero Dynamix (USA)
Aero Precision (USA)
Aeromaoz (ISRAEL)
Aeronautical & General Instruments (UK)
Aerospace & Defence Products (AUSTRALIA)
Air Asia Company (TAIWAN)
Air Methods (USA)
Airbus Helicopters (FRANCE)
Astronics DME (USA)
Astronics Luminescent Systems (USA)
Astronics Luminescent Systems (Europe) (BELGIUM)
Aviall Australia (AUSTRALIA)
Avionics Technologies (USA)
B/E Aerospace (USA)
BE Meyers (USA)
Carmanah Aviation (CANADA)
CILAS (FRANCE)
Comtronic (GERMANY)
Consolite Technology (UK)
Control Products (USA)
Dakota Air Parts International (USA)
Defense Holdings (USA)
Diehl Aerosystems (GERMANY)
DO Systems (UK)
Downing Heliport Systems (USA)
Emteq (USA)
Executive Instruments (USA)
Helispec (USA)
Helylux Industries (FRANCE)
HISS (CANADA)
Hoffman Engineering (USA)
Honeywell Aerospace (USA)
IAI North America (USA)
Interface Displays & Controls (USA)
Leonardo DRS (USA)
LFD (UK)
Luma Technologies (USA)
Luminator Aerospace (USA)
Meeker Aviation (USA)
Metalite Aviation Lighting (UK)
MH-Technologies (FRANCE)
Ordtech Military Industries (SWITZERLAND)
Orion Solar Solutions (AUSTRALIA)
Oxley Group (UK)
Oxley Inc (USA)
Paramount Panels (UK)
Paravion Technology (USA)
Patriot Taxiway Industries (USA)
Phantom Products (USA)
Powervamp (UK)
REB Technologies (USA)
Ross Aviation (UK)
Seitz Scientific Industries (USA)
Sloane Helicopters (UK)
Spectrolab (USA)
ST Aerospace (SINGAPORE)
Thommen Aircraft Equipment (SWITZERLAND)
Thommen America (USA)
Trakka Systems Australia (AUSTRALIA)
Trakka Systems Sweden (SWEDEN)
Trakka Systems USA (USA)
Transaero (USA)
Ultra Electronics Communication & Integrated Systems (UK)
Ultra Electronics Precision Air & Land Systems (UK)
US Night Vision (USA)
UTC Aerospace Systems (USA)
Vector Aerospace Helicopter Services - UK (UK)
Wamco (USA)
Wilco International (FRANCE)

Maintenance, Repair and Overhaul

3M Aerospace (USA)
Able Aerospace (USA)
ACES Systems (USA)
AD-S&Co (NETHERLANDS)
Advanced Helicopter Services (USA)
Advanced Surfaces & Processes (USA)
AECOM (USA)
AEM (UK)
Aero Dynamix (USA)
Aero Precision (USA)
Aero Propulsion Support Group (USA)
Aero Telemetry (USA)
Aerodata (GERMANY)
Aerospace & Defence Products (AUSTRALIA)
Aerostar (ROMANIA)
Aerowing (USA)
AGC Aerospace & Defense (USA)
Air & Ground (UK)
Air Asia Company (TAIWAN)
Air Methods (USA)
Air Nautics Consultants (SWITZERLAND)
Air Technology Engines (USA)
Air - Transport Europe (SLOVAKIA)
Airborne Industries (USA)
Airbus Helicopters (FRANCE)
Alkan (FRANCE)
Alpine Aerotech (CANADA)
Ametek Aerospace & Defense (USA)
ASE (ITALY)
Asia Pacific Aerospace (AUSTRALIA)
Asia Pacific Aerospace (Singapore) (SINGAPORE)
ASU Baltija (LITHUANIA)
Autoflug (GERMANY)
Aviall Australia (AUSTRALIA)
Aviation Export Intl. (USA)
Avion/AvTask (USA)
Barnes Aerospace (USA)
Barum & Dewar (UK)
Becker Avionics GmbH (GERMANY)
Bell Helicopter Textron (USA)
Bet Shemesh Engines (ISRAEL)
Bristow Helicopters (UK)
Camber (USA)
CHT Aerospace (CANADA)
Claverham (UK)
Cliffdale Manufacturing (USA)
Cobham Aviation Services, Helicopter Services (UK)
Codarra Advanced Systems (AUSTRALIA)
Columbia Helicopters (USA)
Corpus Christi Army Depot (USA)
Crane Aerospace & Electronics (USA)
Dakota Air Parts International (USA)
Denel Aviation (SOUTH AFRICA)
DMS Technologies (UK)
DynCorp International (USA)
Eagle Copters (CANADA)
EAI - Emirates Advanced Investments Group (UAE)
Eaton Aerospace (USA)
Eaton Aerospace - Fuel & Motion Control Systems Division (UK)
EDMO Distributors (USA)
Emergency Beacon (USA)
Euravia (UK)
Executive Instruments (USA)
FDC/aeroFilter (USA)
Fokker Services (NETHERLANDS)
Gama Engineering (UK)
GE Aviation (USA)
Global Turbine Component Technologies (USA)
HAL - Hindustan Aeronautics (INDIA)
Hawker Pacific (AUSTRALIA)
Hawker Pacific Aerospace (USA)
Hayward & Green Aviation (UK)
Headset Services (UK)
Heatcon Composite Systems (USA)
Heli-Mart (USA)
Heli-One (CANADA)
Heli-One Europe (NORWAY)
Heli-One USA (USA)
Helicopter Engines MRO (HE-MRO) (INDIA)
Helicopter Support (USA)
Helispec (USA)
Honeywell Aerospace (USA)
Hupp Aerospace/Defense (USA)
Hydromechanical Engineering (ISRAEL)
IAI Lahav (ISRAEL)
IAI North America (USA)
IAR Brasov (ROMANIA)
Indonesian Aerospace (INDONESIA)
ITP Group (SPAIN)
Kaman Aerospace (USA)
L3 Army Fleet Support (USA)
L3 Communications MAS Canada (CANADA)
Leonardo Helicopters (ITALY)
Liebherr Aerospace & Transportation (GERMANY)
Limco Airepair (USA)
Luma Technologies (USA)
M International (USA)
M1 Support Services (USA)
MAC Aerospace (USA)
Masley Enterprises (USA)
McDermott Aviation (AUSTRALIA)
MD Helicopters (USA)
Mecaer Aviation Group (ITALY)
Moog Components Group (USA)
Motorflug Baden-Baden (GERMANY)
Navigator Development Group (USA)
NSE (FRANCE)
Nusantara Turbin & Propulsi (NTP) (INDONESIA)
Oceania Aviation (NEW ZEALAND)
Ordtech Military Industries (SWITZERLAND)
Pacific Oil Cooler Service (USA)
Parker Aerospace - Aircraft Wheels & Brakes (USA)
Parker Aerospace - Control Systems (USA)
Parker Aerospace - Fluid Systems Division (USA)
Patria Helicopters AB (SWEDEN)
PCC Aerostructures, Helicomb International (USA)
Pro Star Aviation (USA)
PZL-Świdnik (POLAND)
RBI Hawker (UAE)
REB Technologies (USA)
Resource Group UAS (UK)

RF System Lab (USA)
Rockwell Collins (USA)
Rolls-Royce (UK)
Rolls-Royce Deutschland (GERMANY)
Rosebank Engineering (AUSTRALIA)
Rotor Blades (USA)
Rotor Blades UK (UK)
Rotor-Tech International (USA)
Rotorcraft Services Group (USA)
RUAG Aviation (SWITZERLAND)
Russian Helicopters (RUSSIA)
Russian Helicopters (Kazan) (RUSSIA)
Sabena technics (FRANCE)
Safran Helicopter Engines (FRANCE)
Saint-Gobain Sully (FRANCE)
Science and Engineering Services (USA)
Servo Kinetics (USA)
Sikorsky Helitech (AUSTRALIA)
Sikorsky, a Lockheed Martin Company (USA)
Snap-on Tools International (USA)
ST Aerospace (SINGAPORE)
StandardAero (USA)
Star Aviation Inc (USA)
Tapestry Solutions (USA)
Textron Systems (USA)
Thomas Instrument (USA)
Times Aerospace Korea (SOUTH KOREA)
Transupport (USA)
Triumph Gear Systems (USA)
Uniflight (USA)
United Rotorcraft (USA)
UTC Aerospace Systems - Actuation Systems France (FRANCE)
Vector Aerospace Asia Pacific (MALAYSIA)
Vector Aerospace Helicopter Services - UK (UK)
Vector Aerospace Helicopter Services North America (CANADA)
Vertical (COLOMBIA)
VT Group Technical Services (USA)
Xenics (BELGIUM)
Yulista Aviation (USA)
ZF Luftfahrttechnik (GERMANY)
Zodiac Aerospace Services (FRANCE)

Materials/Aerostructures

3M Aerospace (USA)
ADEPT Technologies (USA)
Advanced Helicopter Services (USA)
Aero Precision (USA)
Aero Propulsion Support Group (USA)
AGC Aerospace & Defense (USA)
Air Covers (UK)
Akzo Nobel Aerospace Coatings (USA)
Alion Science and Technology (USA)
Alion Science and Technology Rapid Engineering Solutions (USA)
Alkan (FRANCE)
Alpine Aerotech (CANADA)
Aurora Flight Sciences (USA)
Automated Dynamics (USA)
Av-DEC (USA)
Avion Solutions (USA)
Barnes Aerospace (USA)
Battelle Memorial Institute (USA)
Composiflex (USA)
Dayton-Granger (USA)
East/West Industries (USA)
Fulcrum Concepts (USA)
Greene Tweed (USA)
Hawker Pacific Aerospace (USA)
Heatcon Composite Systems (USA)
Hontek (USA)
Indonesian Aerospace (INDONESIA)
Kaman Aerospace (USA)
Kanfit (ISRAEL)
L3 Communications MAS Canada (CANADA)
LaBrOs Engineering (GERMANY)
Lancer Systems (USA)
LifePort (USA)
Lord (USA)
Magellan Aerospace (CANADA)
Middletown Composites (USA)
Morgan Advanced Materials Composites and Defence Systems (UK)
Motorflug Baden-Baden (GERMANY)
MTL Advanced (UK)
Oceania Aviation (NEW ZEALAND)
Ordtech Military Industries (SWITZERLAND)
Patria Aviation (FINLAND)
Polyformes (UK)
PPG Aerospace (USA)
Rosebank Engineering (AUSTRALIA)
S.A.B.C.A. (BELGIUM)
Senior Aerospace Metal Bellows (USA)
Seyer Industries (USA)
Spokane Industries (USA)
ST Aerospace (SINGAPORE)
Stop-choc (UK)
Tighitco (USA)
Timken (USA)
Triumph Fabrications (USA)
Yulista Aviation (USA)

Navigation Systems

Aerlyper (SPAIN)
Aero Precision (USA)
Aero Telemetry (USA)
AeroComputers (USA)
Aerodata (GERMANY)
Aeronautical & General Instruments (UK)
Aeronautics (ISRAEL)
Air Methods (USA)
Airbus Defence & Space (FRANCE)
Airbus Defence & Space (GERMANY)
Airbus Defence & Space (UK)
Aselsan (TURKEY)
Astronautics Corporation of America (USA)
ASU Baltija (LITHUANIA)
Avalex Technologies (USA)
Aviall Australia (AUSTRALIA)
Avibras Indústria Aeroespacial (BRAZIL)
BAE Systems (UK)
BAE Systems Electronic Systems (USA)
BAE Systems Inc (USA)
Becker Avionics USA (USA)
Bharat Electronics (INDIA)
Cast Navigation (USA)
Churchill Navigation (USA)
CILAS (FRANCE)
Claverham (UK)
Cooper Antennas (UK)
Dallas Avionics (USA)
EDMO Distributors (USA)
Elbit Systems (ISRAEL)
Emteq (USA)
Esterline CMC Electronics (CANADA)
EuroAvionics Navigationssysteme (GERMANY)
Euroavionics UK (UK)
Garmin International (USA)
Garmin UK (UK)
GE Aviation (USA)
General Dynamics Mission Systems (USA)
Harmonic Drive (USA)
Hawker Pacific (AUSTRALIA)
HeliMedia (UK)
Honeywell Aerospace (USA)
Honeywell UK (Skyforce) (UK)
HR Smith Group of Companies (UK)
IAI Lahav (ISRAEL)
IAI North America (USA)
IAI Tamam (ISRAEL)
KVH Industries (USA)
L3 Avionics Systems (USA)
L3 Communications Randtron Antenna Systems (USA)
Leonardo Airborne & Space Systems (ITALY)
Leonardo Helicopters (ITALY)
Liteye Systems (USA)
LKD Aerospace (USA)
Lockheed Martin UK (UK)
MacTaggart Scott (UK)
Moog Components Group (USA)
Motorflug Baden-Baden (GERMANY)
Navtech Systems (UK)
Northrop Grumman (USA)
Northrop Grumman Navigation Systems (USA)
Optical Air Data Systems (USA)
Paravion Technology (USA)
Raytheon (USA)
Rockwell Collins (USA)
Rockwell Collins (FRANCE)
Rockwell Collins (UK)
RUAG Aviation (SWITZERLAND)
Saab (SWEDEN)
Safe Flight Instrument Corp (USA)
Sandel Avionics (USA)
Sandia Aerospace (USA)
Scandinavian Avionics (DENMARK)
SkyNet Mobile Communications (AUSTRALIA)
Sloane Helicopters (UK)
ST Aerospace (SINGAPORE)
Textron Systems (USA)
Thales (FRANCE)
Thales Defense & Security (USA)
Thales UK (UK)
ThalesRaytheonSystems (FRANCE)
Times Microwave Systems (USA)
Trimble (USA)
UTC Aerospace Systems - Actuation Systems (Microtecnia S.r.l.) (ITALY)
Vector Aerospace Helicopter Services - UK (UK)

NV, EO Equipment

Aage Christensen (DENMARK)
Aerlyper (SPAIN)
Aero Dynamix (USA)
Aeromaoz (ISRAEL)
Aeronautical & General Instruments (UK)
Aeronautics (ISRAEL)
Aerospace & Defence Products (AUSTRALIA)
Airbus Defence & Space (Germany) (GERMANY)
Airbus Defence & Space (UK)
Artemis Optical (UK)
Aselsan (TURKEY)
Aviation Specialties Unlimited (USA)
Axnes Aviation (NORWAY)
BAE Systems (UK)
BAE Systems Electronic Systems (USA)
BAE Systems Inc (USA)
Ball Aerospace (USA)

BCB International (UK)
BE Meyers (USA)
Bharat Electronics (INDIA)
Boeing Defense, Space & Security (USA)
Britannia 2000 (UK)
Comtronic (GERMANY)
Consolite Technology (UK)
Control Products (USA)
Controp Precision Technologies (ISRAEL)
Daylight Solutions (USA)
Defence Vision Systems (UK)
DO Systems (UK)
Dynetics (USA)
e2v (UK)
Elbit Systems EW & SIGINT - Elisra (ISRAEL)
Elbit Systems Intelligence and Electro-optics - Elop (ISRAEL)
Elbit Systems of America (USA)
Emteq (USA)
Executive Instruments (USA)
Flight Helmets Australia (AUSTRALIA)
FLIR Systems (USA)
FLIR Systems (UK) (UK)
Fraser Optics (USA)
Gamma Scientific (USA)
GE Intelligent Platforms (UK)
GeoSim Technologies (AUSTRALIA)
Harris Communication Systems (USA)
Headset Services (UK)
Helmet Integrated Systems (UK)
Helylux Industries (FRANCE)
Hensoldt Optronics GmbH (GERMANY)
Hensoldt Sensors (GERMANY)
HISS (CANADA)
Hoffman Engineering (USA)
Honeywell Aerospace (USA)
IAI Israel Aerospace Industries (ISRAEL)
IAI Lahav (ISRAEL)
IAI North America (USA)
IAI Tamam (ISRAEL)
Interactive Safety Products (USA)
Intevac (USA)
L3 Advanced Laser Systems Technology (USA)
L3 Cincinnati Electronics (USA)
L3 Sonoma EO (USA)
L3 Wescam (CANADA)
Leonardo Land & Naval Defence Electronics (ITALY)
Liteye Systems (USA)
LKD Aerospace (USA)
Lockheed Martin Rotary and Mission Systems (USA)
Luma Technologies (USA)
Luminator Aerospace (USA)
Lumitron Aerospace Lighting Components (USA)
Max-Viz (USA)
Meeker Aviation (USA)
MH-Technologies (FRANCE)
Motorflug Baden-Baden (GERMANY)
Newcon Optik (CANADA)
Night Flight Concepts (USA)
Night Readiness (USA)
Northrop Grumman (UK)
NSE (FRANCE)
NVIO (USA)
OIP Sensor Systems (BELGIUM)
Ophir Optics LLC (USA)
Oppenheimer Precision Products (USA)
Optix (BULGARIA)
Oxley Inc (USA)
Photo-Sonics International (UK)
Photonis (FRANCE)
Photonis (NETHERLANDS)
Qioptiq (UK)
Qioptiq (SINGAPORE)
Raytheon (USA)
Raytheon Space & Airborne Systems (USA)
REB Technologies (USA)
RUAG Aviation (SWITZERLAND)
Saab (SWEDEN)
Scandinavian Avionics (DENMARK)
Sekai Electronics (USA)
Sloane Helicopters (UK)
Spectrolab (USA)
ST Aerospace (SINGAPORE)
SWESYSTEM (SWEDEN)
TDL-Tulip Development Laboratory (USA)
Thales (FRANCE)
Thales UK (UK)
ThalesRaytheonSystems (FRANCE)
Thomas Jacks (UK)
TNO (NETHERLANDS)
Transaero (USA)
United Rotorcraft (USA)
Urals Optical and Mechanical Plant UOMZ (RUSSIA)
US Night Vision (USA)
UTC Aerospace Systems (USA)
Wamco (USA)
Wilco International (FRANCE)
Xenics (BELGIUM)

Radar

Aeronautics (ISRAEL)
Airbus Defence & Space (GERMANY)
Airbus Defence & Space (UK)
BAE Systems (UK)
BAE Systems Electronic Systems (USA)
Curtiss-Wright Defense Solutions (USA)
Curtiss-Wright Defense Solutions UK (UK)
Elbit Systems EW & SIGINT - Elisra (ISRAEL)
Emteq (USA)
General Atomics Aeronautical Systems (USA)
Honeywell International (USA)
IAI ELTA Systems (ISRAEL)
IAI Lahav (ISRAEL)
IAI North America (USA)
Indra Sistemas (SPAIN)
Leonardo Airborne & Space Systems (ITALY)
Leonardo Helicopters (ITALY)
Lockheed Martin Rotary and Mission Systems (USA)
Mercury Systems (USA)
Northrop Grumman (USA)
Northrop Grumman (UK)
PJSC Kiev Radar Plant (UKRAINE)
Raytheon (USA)
RUAG Aviation (SWITZERLAND)
Saab North America (USA)
SRC (USA)
ST Aerospace (SINGAPORE)
Teledyne Defence & Space (UK)
Telephonics (USA)
Thales UK (UK)
ThalesRaytheonSystems (FRANCE)

Rockets and Launchers

Arnold Defense (USA)
Autoflug (GERMANY)
BAE Systems (UK)
CFD International (USA)
Denel Dynamics (SOUTH AFRICA)
FN Herstal (BELGIUM)
Forges de Zeebrugge (BELGIUM)
General Dynamics Ordnance and Tactical Systems (USA)
GriggTech (USA)
IMI Systems (ISRAEL)
KBP Instrument Design Bureau (RUSSIA)
Lockheed Martin Missiles and Fire Control (USA)
Magellan Aerospace (CANADA)
MBDA (FRANCE)
MBDA Italia (ITALY)
MBDA UK (UK)
Moog Aircraft Group (USA)
Orbital ATK (USA)
Orbital ATK Armament Systems (USA)
Ordtech Military Industries (SWITZERLAND)
Raytheon (USA)
Roketsan (TURKEY)
Rosoboronexport (RUSSIA)
SpaceX (USA)
Tactical Missiles Corporation (RUSSIA)
TDA Armements (FRANCE)
Vympel (RUSSIA)

Rotor Systems

ACES Systems (USA)
Air Asia Company (TAIWAN)
Aurora Flight Sciences (USA)
Avion/AvTask (USA)
BLR Aerospace (USA)
Columbia Helicopters (USA)
Dakota Air Parts International (USA)
Dynatech International (USA)
Hawker Pacific (AUSTRALIA)
Hawker Pacific Aerospace (USA)
Hawker Pacific Middle East (UAE)
Helitune (UK)
Kaman Aerospace (USA)
Lord (USA)
Rotor Blades (USA)
Rotor Blades UK (UK)
RUAG Aviation (SWITZERLAND)
Russian Helicopters (RUSSIA)
Sikorsky, a Lockheed Martin Company (USA)
ST Aerospace (SINGAPORE)
Triumph Gear Systems (USA)
Vector Aerospace Helicopter Services - UK (UK)
Vector Aerospace Helicopter Services North America (CANADA)
Vertical (COLOMBIA)

Seats

Aerolite (SWITZERLAND)
Air & Ground (UK)
Airbus Helicopters (FRANCE)
All-System Aerospace International (USA)
Autoflug (GERMANY)
BAE Systems (UK)
Dakota Air Parts International (USA)
East/West Industries (USA)
Fischer + Entwicklungen (GERMANY)
IAI Golan Industries (ISRAEL)
IAI North America (USA)
LifePort (USA)
Martin-Baker Aircraft Company (UK)
Oregon Aero (USA)
Team Wendy (USA)
UTC Aerospace Systems - Interiors, Lighting Systems (GERMANY)

Simulators

Aechelon Technology (USA)
AEgis Technologies (USA)
Aero Simulation (USA)
Aeromaoz (ISRAEL)
Aeronautics (ISRAEL)
Aerosim Technologies (USA)

AeroSimulators Group (BELGIUM)
AeroSimulators USA (USA)
Airbus Defence & Space (GERMANY)
Airbus Defence & Space (UK)
Alion Science and Technology (USA)
Aviation Training International (UK)
Barum & Dewar (UK)
Bell Helicopter Textron (USA)
Bihrle Applied Research (USA)
Bristow Helicopters (UK)
CAE (CANADA)
CAE Integrated Enterprise Solutions (CANADA)
CAE USA (USA)
Camber (USA)
Cast Navigation (USA)
CHC Helicopter (CANADA)
Christie Digital Systems USA (USA)
Cobham Aviation Services, Helicopter Services (UK)
Codarra Advanced Systems (AUSTRALIA)
Control Products (USA)
CSTS Dinamika (RUSSIA)
Cursive Simulation (UK)
domeprojection.com (GERMANY)
DTM Global (UK)
DynCorp International (USA)
EDM (UK)
Elbit Systems (ISRAEL)
Elbit Systems EW & SIGINT - Elisra (ISRAEL)
ETC (Environmental Tectonics) (USA)
Frasca International (USA)
GasTOPS (CANADA)
GDI Simulation (FRANCE)
General Dynamics Mission Systems (CANADA)
GeoSim Technologies (AUSTRALIA)
Helisim (FRANCE)
IAI Lahav (ISRAEL)
IAI MLM Division (ISRAEL)
IAI North America (USA)
Inter-Coastal Electronics (USA)
InterSense (USA)
J.F. Taylor, Inc. (USA)
KF Aerospace (CANADA)
L3 Communications MAS Canada (CANADA)
L3 Link Simulation & Training (USA)
L3 Link Simulation and Training UK (UK)
Leonardo (ITALY)
Leonardo Helicopters (ITALY)
Leonardo UK (UK)
Lockheed Martin UK (UK)
Mercury Systems (USA)
Moog Aircraft Group (USA)
NGRAIN (CANADA)
Night Readiness (USA)
Northrop Grumman (USA)
Polysim Swiss Simulation (SWITZERLAND)
Presagis (CANADA)
QinetiQ (UK)
QinetiQ cueSim (UK)
RCAF International Training Programs (ITP) (CANADA)
RGB Spectrum (USA)
Rockwell Collins (USA)
RUAG Aviation (SWITZERLAND)
Scientific Management Associates (AUSTRALIA)
Servo Kinetics (USA)
Seyer Industries (USA)
szenaris (GERMANY)
Textron Systems Electronic Systems UK (UK)
Thales (FRANCE)
Thales Training & Simulation France (FRANCE)
Thales UK (UK)
TNO (NETHERLANDS)
URS Training & Simulation Engineering Team (TSET) (USA)
Virtalis (UK)
Virtual Reality Media (SLOVAKIA)
Wyle (USA)
XPI Simulation (UK)

Software

Altair Engineering (USA)
Avion Solutions (USA)
Camber (USA)
DXC Technolgy (USA)
Dynetics (USA)
Helitune (UK)
ID Integration (USA)
McLane Advanced Technologies (USA)
RDDS Avionics (UK)
RedViking (USA)
Resource Group UAS (UK)
Safety Research Corporation of America (USA)
Sentient (AUSTRALIA)
SimAuthor (USA)
Wind River (USA)
Wyle (USA)

Sonar, Sonobuoys and Acoustic Processing

Alkan (FRANCE)
Bharat Electronics (INDIA)
General Dynamics Mission Systems - Canada (CANADA)
Harris Communication Systems (USA)
L3 Ocean Systems (USA)
Lockheed Martin UK (UK)
Moog Components Group (USA)
Ordtech Military Industries (SWITZERLAND)
Raytheon (USA)
State Enterprise Kyiv Scientific Research Institute of Hydrodevices (UKRAINE)
Thales (FRANCE)
TNO (NETHERLANDS)
Ultra Electronics Communication & Integrated Systems (UK)
Ultra Electronics Precision Air & Land Systems (UK)

Spare Parts

Aage Christensen (DENMARK)
Able Aerospace (USA)
AD-S&Co (NETHERLANDS)
Adams Aviation (UK)
ADEPT Technologies (USA)
Advanced Helicopter Services (USA)
Aero Precision (USA)
Aero Propulsion Support Group (USA)
Air & Ground (UK)
Air Asia Company (TAIWAN)
Air Methods (USA)
Air Nautics Consultants (SWITZERLAND)
Air Technology Engines (USA)
Air - Transport Europe (SLOVAKIA)
Airborne Industries (USA)
Airbus Helicopters (FRANCE)
Aircraft & Commercial Enterprises (USA)
Alkan (FRANCE)
All-System Aerospace International (USA)
AmSafe Logistics & Support (UK)
Applied Avionics (USA)
ASU Baltija (LITHUANIA)
Autoflug (GERMANY)
Aviall (USA)
Aviall Australia (AUSTRALIA)
Aviatrix (USA)
B/E Aerospace (USA)
Barnes Aerospace (USA)
Bell Helicopter Textron (USA)
BLR Aerospace (USA)
Cliffdale Manufacturing (USA)
Control Devices Australia (AUSTRALIA)
Control Products (USA)
Corpus Christi Army Depot (USA)
Crestwood Technology Group (USA)
Dakota Air Parts International (USA)
DART Aerospace (CANADA)
Diehl Aerosystems (GERMANY)
DIMO (USA)
Dunlop Aircraft Tyres (UK)
Dynatech International (USA)
Eaton Aerospace - Fuel & Motion Control Systems Division (USA)
FDC/aeroFilter (USA)
Fokker Services (NETHERLANDS)
Gama Engineering (UK)
GE Aviation (USA)
George Keen Lee Equipment (SINGAPORE)
Global Turbine Component Technologies (USA)
Goodyear Aviation Tires (NETHERLANDS)
Greene Tweed (USA)
Groupe SAI (FRANCE)
Hawker Pacific (AUSTRALIA)
Hawker Pacific Aerospace (USA)
Hawker Pacific Middle East (UAE)
Hayward & Green Aviation (UK)
Headset Services (UK)
Heli-Mart (USA)
Heli-One (CANADA)
Heli-One Europe (NORWAY)
Heli-One USA (USA)
Heliatica (RUSSIA)
Helicopter Support (USA)
HeliNetwork International (FRANCE)
Helispec (USA)
IAI North America (USA)
Indonesian Aerospace (INDONESIA)
Inventory Locator Service (USA)
L3 Communications MAS Canada (CANADA)
L3 Wescam (CANADA)
Lee Products (UK)
LKD Aerospace (USA)
Lord (USA)
MAC Aerospace (USA)
McDermott Aviation (AUSTRALIA)
MD Helicopters (USA)
Moog Components Group (USA)
Motorflug Baden-Baden (GERMANY)
Oceania Aviation (NEW ZEALAND)
Ordtech Military Industries (SWITZERLAND)
Pacific Oil Cooler Service (USA)
Parker Aerospace - Aircraft Wheels & Brakes (USA)
Patria Helicopters AB (SWEDEN)
PM Research (USA)
RBI Hawker (UAE)
Rolls-Royce (UK)
Ross Aviation (UK)
Rotor Blades (USA)
Rotor Blades UK (UK)
Rotorcraft Services Group (USA)
Russian Helicopters (RUSSIA)
Saint-Gobain Sully (FRANCE)

Senior Aerospace Metal Bellows (USA)
Sikorsky Helitech (AUSTRALIA)
SKF Aerospace (USA)
Sloane Helicopters (UK)
Specialist Aviation Services (UK)
Spectrum Associates (USA)
ST Aerospace (SINGAPORE)
Staco Systems (USA)
Stag Group (UK)
Times Aerospace Korea (SOUTH KOREA)
Times Microwave Systems (USA)
Transaero (USA)
Triumph Gear Systems (USA)
UTC Aerospace Systems - Actuation Systems France (FRANCE)
UTC Aerospace Systems - Engine Components, Power Transmission Systems (USA)
UTC Aerospace Systems - Wheels and Brakes (USA)
Vector Aerospace Helicopter Services North America (CANADA)
Wencor (USA)
ZF Luftfahrttechnik (GERMANY)
Zodiac Aerospace Services (FRANCE)

Survival, Safety Equipment

Aage Christensen (DENMARK)
AD Aerospace (UK)
Adams Aviation (UK)
ADS (USA)
AEM (UK)
Aerlyper (SPAIN)
Aero Sekur (UK)
Airborne Systems North America (USA)
Airbus Helicopters (FRANCE)
AmSafe Defense (USA)
Armor Australia (AUSTRALIA)
ArmorWorks (USA)
Armour of America (USA)
Astronics DME (USA)
ASU Baltija (LITHUANIA)
Autoflug (GERMANY)
Battelle Memorial Institute (USA)
BCB International (UK)
Becker Avionics GmbH (GERMANY)
Becker Avionics USA (USA)
Breeze-Eastern (USA)
Brief Relief (USA)
Bruggemann (GERMANY)
Ceradyne (USA)
Combat Medical Systems (USA)
Composiflex (USA)
Dale Techniche (UK)
DART Aerospace (CANADA)
Defense Holdings (USA)
DIMO (USA)
Doctor Down (USA)
Drallim Industries (UK)
DRIFIRE (USA)
DRS Training & Control Systems (USA)
East/West Industries (USA)
Emergency Beacon (USA)
Essex Industries (USA)
Extant Aerospace (USA)
Fischer + Entwicklungen (GERMANY)
Flexible Lifeline Systems (USA)
Flight Helmet (USA)
Flight Helmets Australia (AUSTRALIA)
Heli-One (CANADA)
Heli-One Europe (NORWAY)
Heli-One USA (USA)
Helmet Integrated Systems (UK)
Helylux Industries (FRANCE)
Hontek (USA)
HR Smith Group of Companies (UK)
IAI Lahav (ISRAEL)
IAI MLM Division (ISRAEL)
IMI Systems (ISRAEL)
L3 Electrodynamics (USA)
Life Safety Systems (USA)
Life Support International (USA)
LifePort (USA)
Lifesaving Systems (USA)
Lite Flite (DENMARK)
Magellan Aerospace (CANADA)
Martin-Baker Aircraft Company (UK)
Masley Enterprises (USA)
Medical Innovations Group (UK)
Meeker Aviation (USA)
Meggitt Avionics (UK)
Midwest Industrial Supply (USA)
Mobilarm (AUSTRALIA)
Morgan Advanced Materials Composites and Defence Systems (UK)
MSA Gallet (FRANCE)
MTL Advanced (UK)
Mustang Survival (CANADA)
Naval Group (FRANCE)
Newcon Optik (CANADA)
Optical Air Data Systems (USA)
P-Team (SLOVENIA)
Patria Aviation (FINLAND)
Plasan Sasa (ISRAEL)
PPG Aerospace (USA)
Protective Group (USA)
Rheinmetall Ballistic Protection (GERMANY)
S.O.S. Group (UK)
Safe Flight Instrument Corp (USA)
SCHROTH Safety Products (GERMANY)
SEI Industries (CANADA)
Skedco (USA)
Specmat Technologies (USA)
Spectrum Aeromed (USA)
Survival Products (USA)
Switlik Parachute Company (USA)
Team Wendy (USA)
TenCate Advanced Armor (USA)
Transaero (USA)
Ultra Electronics Precision Air & Land Systems (UK)
UTC Aerospace Systems - Interiors, Lighting Systems (GERMANY)
Viking Life-Saving Equipment (DENMARK)
W.L. Gore & Associates (USA)
W.L. Gore & Associates Cables (UK)
Wilco International (FRANCE)
Xenics (BELGIUM)
Yulista Aviation (USA)
Zodiac Aerosafety Systems (Parachute & Protection) (FRANCE)

Testing, Research

AEgis Technologies (USA)
Air Asia Company (TAIWAN)
Air Technology Engines (USA)
Airbus Helicopters (FRANCE)
Alava Ingenieros (SPAIN)
Altair Engineering (USA)
Anodyne Electronics Manufacturing Corp (CANADA)
Aurora Flight Sciences (USA)
Autoflug (GERMANY)
Avion Solutions (USA)
AVX Aircraft (USA)
Barum & Dewar (UK)
Battelle Memorial Institute (USA)
Bell Helicopter Textron (USA)
Bet Shemesh Engines (ISRAEL)
Bihrle Applied Research (USA)
BLR Aerospace (USA)
Bonham Technologies (USA)
Cantine Armament (USA)
Capital Avionics (USA)
Cast Navigation (USA)
Cox & Company (USA)
Dayton T. Brown (USA)
DO Systems (UK)
Dynetics (USA)
Elbit Systems Intelligence and Electro-optics - Elop (ISRAEL)
Electronic Concepts & Engineering (USA)
ENSCO Avionics (USA)
FDC/aeroFilter (USA)
Florida Turbine Technologies (USA)
Gamma Scientific (USA)
GasTOPS (CANADA)
Harris Communication Systems (USA)
Hawker Pacific (AUSTRALIA)
Helitune (UK)
Helylux Industries (FRANCE)
Hydromechanical Engineering (ISRAEL)
Intuitive Research and Technology (USA)
Kratos Defense and Security Solutions (USA)
Kratos Microwave Electronics Division (USA)
Leidos (USA)
M1 Support Services (USA)
Martin-Baker Aircraft Company (UK)
Meggitt Avionics (UK)
MJ Cases (UK)
Northrop Grumman (USA)
Oklahoma State University - University Multispectral Laboratories (OSU-UML) (USA)
Optical Air Data Systems (USA)
Ordtech Military Industries (SWITZERLAND)
PCC Aerostructures, Helicomb International (USA)
Photo-Sonics International (UK)
Piasecki Aircraft (USA)
PZL-Świdnik (POLAND)
QinetiQ (UK)
QinetiQ North America (USA)
Radiance Technologies (USA)
RAVCO (USA)
RCAF International Training Programs (ITP) (CANADA)
RedViking (USA)
RENK (GERMANY)
Rosebank Engineering (AUSTRALIA)
Russian Helicopters (RUSSIA)
Saab (SWEDEN)
Servo Kinetics (USA)
SimAuthor (USA)
Snap-on Tools International (USA)
Star Aviation Inc (USA)
STM Savunma Teknolojileri Muhendislik ve Ticaret (TURKEY)
Swedish Defence Materiel Administration, FMV (SWEDEN)
System Studies & Simulation (USA)
T.O.P Wing (ISRAEL)
Technology Service Corp (USA)
Textron Systems (USA)
Thales UK (UK)
Thomas Instrument (USA)
TNO (NETHERLANDS)
Triumph Fabrications (USA)

Ultra Electronics Herley (USA)
Ultra Electronics Precision Air & Land Systems (UK)
ULTRAX Aerospace (USA)
Vector Aerospace Helicopter Services - UK (UK)
Vertical (COLOMBIA)
Wyle (USA)
Xenics (BELGIUM)
Yulista Aviation (USA)
ZF Luftfahrttechnik (GERMANY)

Torpedoes

BAE Systems (UK)
Eurotorp (FRANCE)
Kongsberg Defence & Aerospace (NORWAY)
Raytheon (USA)
Saab (SWEDEN)

Training

Aero Precision (USA)
Aero Simulation (USA)
Aeronautics (ISRAEL)
Aerosim Technologies (USA)
Air Rescue Systems (USA)
Airbus Defence & Space (FRANCE)
Airbus Defence & Space (GERMANY)
Airbus Defence & Space (UK)
Alion Science and Technology (USA)
Alkan (FRANCE)
Aviation Export Intl. (USA)
Aviation Specialties Unlimited (USA)
Aviation Training International (UK)
Bell Helicopter Textron (USA)
Bihrle Applied Research (USA)
Bluedrop Performance Learning (CANADA)
Bristow Academy UK (UK)
Bristow Academy USA (USA)
CAE (CANADA)
CAE Integrated Enterprise Solutions (CANADA)
CAE USA (USA)
Camber (USA)
CHC Helicopter (CANADA)
Christie Digital Systems (USA)
Cobham Aviation Services, Helicopter Services (UK)
Cursive Simulation (UK)
DO Systems (UK)
DTM Global (UK)
DynCorp International (USA)
EDM (UK)
Elbit Systems EW & SIGINT - Elisra (ISRAEL)
Elettronica (ITALY)
ENSCO Avionics (USA)
ESG Elektroniksystem und Logistik (GERMANY)
ETC (Environmental Tectonics) (USA)
EuroAvionics Navigationssysteme (GERMANY)
FlightSafety International (USA)
FlightSafety International (UK)
Fulcrum Concepts (USA)
General Dynamics Mission Systems (CANADA)
General Dynamics Ordnance and Tactical Systems (USA)
GeoSim Technologies (AUSTRALIA)
Hawk Enterprises (USA)
Heatcon Composite Systems (USA)
Heliatica (RUSSIA)
Helisim (FRANCE)
Helylux Industries (FRANCE)
Horizon International Flight Academy (UAE)
IAI MLM Division (ISRAEL)
IAI North America (USA)
Inter-Coastal Electronics (USA)
KBR Australia (AUSTRALIA)
KF Aerospace (CANADA)
Kratos Defense and Security Solutions (USA)
L3 Link Simulation & Training (USA)
Lom Praha (CZECH REPUBLIC)
M1 Support Services (USA)
MD Helicopters (USA)
Motorflug Baden-Baden (GERMANY)
National Test Pilot School (USA)
Navigator Development Group (USA)
Northern Helicopters (SWEDEN)
NVIO (USA)
Presagis (CANADA)
QinetiQ North America (USA)
RAVCO (USA)
RCAF International Training Programs (ITP) (CANADA)
REB Technologies (USA)
Resource Group UAS (UK)
RGB Spectrum (USA)
Rockwell Collins ARINCDirect (USA)
Russian Helicopters (RUSSIA)
Saab (SWEDEN)
Sikorsky Helitech (AUSTRALIA)
SimAuthor (USA)
Sloane Helicopters (UK)
Starlite Aviation (SOUTH AFRICA)
Support Systems Associates (USA)
Survival Systems USA (USA)
System Studies & Simulation (USA)
szenaris (GERMANY)
Tapestry Solutions (USA)
Textron Systems (USA)
Thales UK (UK)
Times Aerospace Korea (SOUTH KOREA)
TNO (NETHERLANDS)
Vertical (COLOMBIA)
Virtalis (UK)
Wyle (USA)
XPI Simulation (UK)

Transmission Systems

Air Asia Company (TAIWAN)
Avio (ITALY)
Columbia Helicopters (USA)
Greene Tweed (USA)
Harmonic Drive (USA)
Helispec (USA)
Leonardo Helicopters (ITALY)
Rolls-Royce North America (USA)
Rolls-Royce UK (UK)
RUAG Aviation (SWITZERLAND)
Russian Helicopters (RUSSIA)
Russian Helicopters (Reductor PM) (RUSSIA)
ST Aerospace (SINGAPORE)
Timken (USA)
Triumph Gear Systems (USA)
UTC Aerospace Systems - Engine Components, Power Transmission Systems (USA)
Vector Aerospace Helicopter Services (UK)
Vector Aerospace Helicopter Services North America (CANADA)
ZF Luftfahrttechnik (GERMANY)

Winches

Advanced Helicopter Services (USA)
Aero Precision (USA)
Airborne Systems North America (USA)
Alkan (FRANCE)
All-System Aerospace International (USA)
Allsop Helikites (UK)
AmSafe Bridport (UK)
AmSafe Defense (USA)
Autoflug (GERMANY)
Breeze-Eastern (USA)
Cliffdale Manufacturing (USA)
DART Aerospace (CANADA)
Drallim Industries (UK)
Harmonic Drive (USA)
Hawker Pacific (AUSTRALIA)
Jenoptik Advanced Systems (USA)
Oceania Aviation (NEW ZEALAND)
RUAG Aviation (SWITZERLAND)
SkyHook Rescue Systems (USA)
Sloane Helicopters (UK)
UTC Aerospace Systems - Sensors & Integrated Systems, Hoist and Winch Products (USA)

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Jeff Jackson, VP Bus Dev

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Knoxville, TN 37932, USA
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T P Brittain, GM

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Robin Walsh, Av Sales/Mkt Dev Mgr

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Chad Fielder, VP Bus Dev

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www.adsgroup.org.uk
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Paul Everitt, Chief Exec

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info@1-ACT.com
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Mark Stevens, New Bus Dev

Advanced Helicopter Services
17986 County Road 94B,
Woodland, CA 95695, USA
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advancedhelicopterservices.com
Tel: +1 530 669 7115 Fax: 669 7547
Sparrow Tang, Pres/CEO

Advanced Surfaces & Processes
85 North 26th Avenue,
Cornelius, OR 97113, USA
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www.advanced-surfaces.com
Tel: +1 503 640 4072
Tom Murray, Coordinator

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sales@advancedtorque.com
www.advancedtorque.com
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www.aechelon.com
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A soldier conducts pre-flight inspections of an AH-64E Apache helicopter in Erbil, Iraq. (Photo: US Army)

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